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Gone But Not Forgotten

THE FIJI DISASTER

COOP'S
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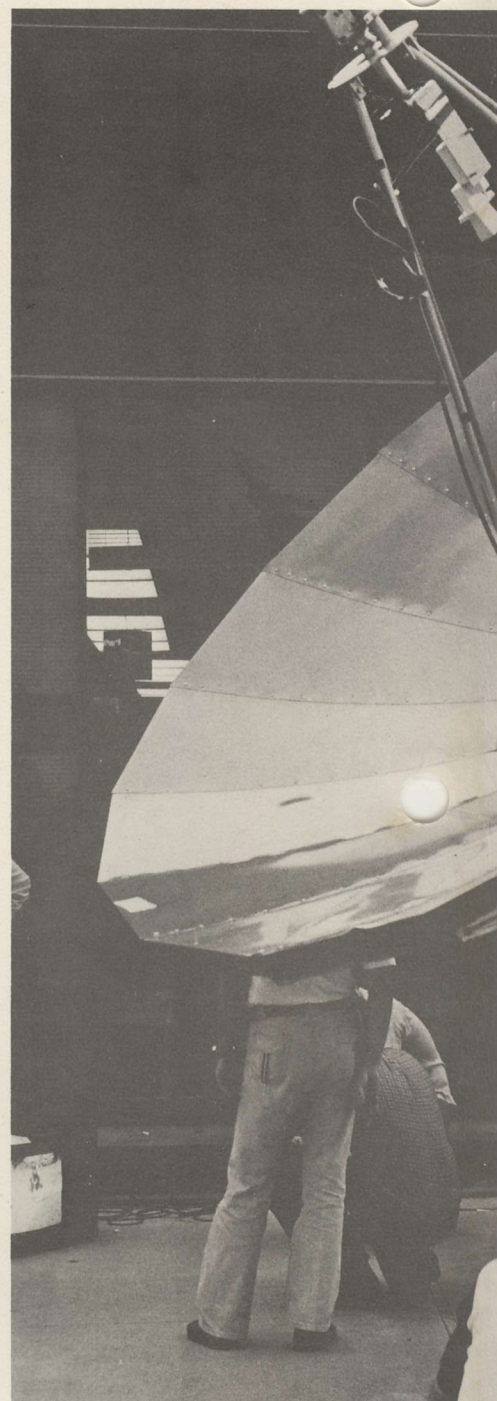


FEBRUARY 1980



WELCOME--SPTS 80!

PARAFRAME



MOST-ADMIRED AT SPTS '79 was the PARAFRAME ET/3.66 (12-foot) TVRO antenna. Those who saw us go "cherry-picking" on Day Two won't soon forget the fine reception we got from ANIK-B, while using a 150°K LNA. That's big performance and if you were there **YOU SAW IT!** For reception photos and product information, write or phone "Mr. Paraframe," Jim Vines.

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COOP'S COMMENT ON TECHNOLOGY

SURVEYING WHAT'S NEEDED

As approximately 1,000 satellite TV enthusiasts, business people and curious invade the Bayfront Park Auditorium in Miami early this month we will be again meeting to see just how far the state of our technology has grown in approximately six months. The August SPTS '79 had a special pioneering spirit attached to it; we battled and beat back a federal court suit that attempted to stop SPTS before it began and we came from more than 40 states and perhaps a dozen countries to learn, share and feel the excitement of an industry being born.

If my reading of the registration forms has any meaning the Miami crowd is somewhat different than the Oklahoma City crowd. There are fewer technical people in attendance (as a proportion of the whole although their numbers may actually be larger since we are dealing with twice as many people) and certainly many more would-be-entrepreneurs who sense in the satellite evolution one or a dozen different business opportunities. Certainly our international reach is far larger; enthusiasts are converging from each of the six continents to attend SPTS and those who have traveled from Australia, Japan, throughout Africa and the middle-east are to be appreciated for their sheer stamina in making the trip.

Now, what do we find in Miami at the first SPTS of 1980 (another will be held in the San Francisco Bay area in June)? First of all we notice that the demand for hardware is suddenly way out of balance with the ability of the suppliers to supply. SPTS delegates from South America, the South Pacific and Africa waiving around \$100,000 to \$1,000,000 Letter-of-Credit backed purchase orders may be upset because few of the firms of hand with hardware in this field at this time have the ability to fulfill such orders. Here are established (foreign to the U.S.) firms qualified to purchase a million dollars or more in satellite TV hardware at a whack unable to find qualified suppliers to fill their orders! Certainly something must change in this area before we all arrive in California at the second SPTS in June.

Next we find a sudden sophistication in low-cost hardware mixed with ever simpler really low cost hardware. We find in this issue of CSD that ten foot reflector surfaces can now be purchased from the OEM for \$520 while at the same time we see some very clever automated 10 to 15 foot antennas on view outside the exhibit hall area in the \$3,000 up range.

In the electronics end we see that Taylor Howard and Robert Coleman have developed a hybrid receiver concept which Coleman has been heard to say 'could be sold' for around \$1800 (LNA + receiver, wired and tested); a complete terminal, less only the reflector surface. At the same time we find that the duo had developed vastly improved phaselock demodulator circuits for the original Howard Terminal receiver and at SPTS '80 circuit boards are finally available for most of their designs. We also find that a new name to the satellite receiver area, Clyde Washburn, is on hand with a very elegant 24 channel tuneable receiver system backed up with circuit boards, parts kits or even wired and tested modules through well known supplier Ramsey Electronics. We also find that Bob Behar's A-B Electronics has a new 24 channel tuneable receiver in the \$1800 price range.

And this touches the surface of what is new and on display at SPTS '80. **Now what is really needed in the way of additional product innovation?** Let's start with 12 GHz. The Canadian ANIK-B satellite is now operational with a couple of English language channels including Canada's first "super station"; Vancouver's CHAN-TV. The first INTELSAT V satellites, also operational (for the first time for INTELSAT) at 12 GHz, are scheduled to be turned on this year. All of the evidence tells us we need some hard and fast 12 GHz design data to start building 12 GHz gear; right now. The 12 GHz band offers inexpensive alternatives to 4 GHz with smaller (3-6 foot) antennas. Who's working on it? Steve Birkill in England is and within months we'll have some construction data on hand here in CSD.

Next we need some lower cost LNA technology. We've watched receivers become simplified and antennas come down in price as their production rates have gone up. LNAs are still \$1000 up boxes and difficult to build (although many are building their own). For an opener, I'd be happy to see a complete high-quality LNA kit on the market. **Complete** means with the proper boards, input matching circuit, parts and housing. Tay Howard had been working on this but he warns me that even with 'characterized' GaAs-FETs he finds the builder has to 'tweek' (as in optimize) each stage for peak performance. That's a problem that needs to be solved since virtually nobody building from a kit could be expected to have access to 4 GHz noise and gain measurement equipment.

What else do we need? Volume production. The capacity to turn out no fewer than 500 private (as in low cost) complete terminals **per week**, as an industry, to be stepped up to 1,000 per week by early in 1981. If we can get the equipment into the marketing stream, it will sell and sell well. Finally, we need to recognize that satellite TV is an international phenomenon, not purely a U.S./Canada development. And that says anyone getting into the hardware game had better be prepared to sell off-shore as well as here in North America. How all of this develops in the next six months will be fascinating indeed.

CSD
TECHNOLOGY



COOP'S SATELLITE DIGEST (Technology Edition) is produced monthly by Satellite Television Technology, P.O. Box G, Arcadia, Oklahoma 73007 (405-396-2574). CSD is available in two separate editions (Technology and Programming) or as a combined subscription. Subscription rates are \$30 per year for first class mail delivery within U.S.A. or Canada for either edition, or \$50 per year for the combined editions. Outside U.S.A. add \$25.00 per year for any subscription. All subscriptions to be paid in advance in U.S. funds drawn on a U.S. bank; no invoicing. Contents are copyright 1980 © by Satellite Television Technology and any duplication or reproduction in any form without written permission is a violation of Federal Statute (17 USC 101 et seq.).

ENGINEERING THE PRIVATE TVRO SYSTEM

INTRODUCTION

The Washburn TVRO receiver is an evolutionary update of the Howard Terminal receiver and was conceived to provide a unit that operates as virtually a consumer appliance with the following significant operational features:

THE WASHBURN TVRO RECEIVER MANUAL

This month Satellite Television Technology begins distribution of a brand new do-it-yourself manual for the low-cost TVRO receiver industry and enthusiast. The **Washburn High Performance TVRO Receiver Manual** is evolutionary in every sense. Engineer Clyde Washburn began his design work with the Howard Terminal receiver having obtained an early copy of the original paper from Tay Howard nearly one year ago. With that design as a starting point Washburn has carefully worked out receiver refinements and improvements which we feel substantially improves the performance of the very popular Howard Terminal designed receiver. Among other things, Washburn has broken the package into three separate, inter-connected modules. The downconverter is separate from the demodulator so that it can be placed at a remote location (such as the building entry point). The demodulator has built-in status monitoring including signal strength monitoring. The demodulator has been designed to produce an 'extended threshold' so that carrier to noise (CNR) ratios as low as 8 dB provide sparklie free reception of program material. The receiver features automatic control of both transponder selection, aural subcarrier selection (6.2 or 6.8), and, antenna polarization selection from a small handheld remote control box. Extras include built-in provision to feed VCR decks and backfeeding of a (local or neighborhood) MATV system.

The manual is being introduced at SPTS '80 Miami. It too is evolutionary. All material has been typeset, all drawings have been professionally 'penned' and schematics are on large fold-out pages where required. And for the first time a complete set of **circuit boards** plus complete or partial parts kits (buyer option) are available from an established source to back up the manual. Additionally, the manual includes complete **PC board layouts** and line drawings showing component part locations. **Step by step alignment** instructions are also provided.

The Washburn Manual is extremely comprehensive. In many ways it is a text designed as much for education in the basics of TVRO reception as it is a text for duplication of a highly innovative, high-performance receiver. This **CSD** feature is a small portion of the introductory 'learning text' found in this new manual.

1) **Distributed construction**...utilizing an out-of-the-way downconverter (mounting separate from the demodulator proper) with an LNA power supply, a feed rotation system (to allow operational remote control of the feed point antenna for separate reception of vertically and horizontally polarized transponders), a small demodulator console with full provisions for constant monitoring of the system performance, and, a hand-held remote control that allows the viewer to adjust the system to each of the 24 channels found on SATCOM birds (or alternately 12 on ANIK, WESTAR birds) with a remote volume control. This design allows operation by a non-technical viewer without the requirement for special instructions.

2) **Extended Threshold**...a state of the art approach to threshold extension that allows sparklie-free reception of program material with CNRs of 8 dB and above, achieved without compromises in IF bandwidth, video bandwidth and with special design attention to maintaining video phase and amplitude linearity as one would expect to find in a high dollar commercial receiver package.

3) **Low distortion audio**...a unique approach to recovering **all** of the audio bandwidth present on the satellite transmission utilizing a true low-distortion, low-noise, high-fidelity audio output with remote volume control and **automatic selection** of either the 6.2 or 6.8 MHz sound subcarriers; with indicators to show which audio subcarriers are present and a priority selection system so that the presence of some other modulation format (such as slow scan video) on 6.2 MHz will not be selected for listening (but a **normal** audio modulated subcarrier on 6.2 MHz on a different transponder **will** be heard). Additionally, CCIR (or ANIK) subcarrier frequencies different from the normal 6.2 and 6.8 MHz North American DOMSAT birds can also be received and de-emphasis supplied by component value changes.

4) **An AFT that works**...as well as the RCA home receiver Colortrak® system and provides a very high overall level of dispersion cancellation, eliminating any need for a complex and expensive frequency synthesis system.

5) **VTR compatible inputs and outputs**...to provide easy back-feeding of a home (or neighborhood) MATV system, plus simple off-bird-recording without additional switching or complex cabling.

6) **Careful component selection**...with attention to balancing costs, performance, reliability, ease of alignment and parts availability.

- 7) **Automatic and precise...** feed rotation control using a readily available, modest-in-cost (TV) antenna rotor assembly.
- 8) **Readily available boards and parts kits...** recognizing that many satellite TV enthusiasts have been hampered in their efforts to construct or acquire their own home satellite terminal by the general shortage of specialized component parts required for many receiver designs, and an even more acute shortage of circuit boards for receiver construction by non-design-engineers, every portion of this receiver is backed up by component parts sourcing **and circuit boards**. Additionally, the user of this manual will find circuit board layouts in this manual with which he may duplicate his own boards if he so wishes.

WHAT SIZE ANTENNA DO I NEED?

The Washburn receiver was originally designed for use with a 10 foot (39.3 dBi gain) antenna and a 120 degree Kelvin (K) LNA in a location penalized by what must be characterized as a 'very low elevation/look angle'. At the time of the basic receiver design RCA F1 was purported to be placing a 36 dBw footprint into western New York. Based upon these known (or believed) figures it seemed like a good idea to design the complete system so that it would exhibit the same (commercial as in CATV) '3 dB excess carrier margin' established for cable systems by the FCC. The original calculation therefore looked like this:

$$\text{Bird EIRP-Path loss} + \text{Ant Gain} = \text{LNA input dBw}$$

$$36 - 196.55 + 39.3 = -121.25 \text{ dBw}$$

To calculate the expected CNR (carrier to noise ratio):

$$\begin{aligned} (T^\circ \text{ LNA} + T^\circ \text{ Ant}) \times \text{Boltzman's Constant} \times \\ \text{I.F. Noise bandwidth} &= \text{Equivalent LNA} \\ \text{Input Noise in dB} &= -23 \\ (120 + 50) \times 1.381 \times 10^{-23} \times 30 \times 10^6 &= \\ -131.52 \text{ dBw} \end{aligned}$$

$$\text{CNR} = \text{LNA input dBw} - \text{equivalent LNA input noise in dBw}$$

$$\begin{aligned} \text{CNR} &= (-) 121.25 - (-) 131.52 \\ \text{CNR} &= 10.30 \text{ dB} \end{aligned}$$

The original receiver design goal called for a 7.3 dB CNR **threshold** which correlated with the magnitude of improvement suggested in the 'theoretical' literature for an **optimum** PLL vs. a (frequency) discriminator circuit under similar conditions. The final system, described here, courtesy of the **actual** 34 dBw region EIRPs which SATCOM F1 is now known to have (versus the earlier RCA data on file with the FCC which promised a 36 dBw EIRP for the northeastern area of the United States), provides measured CNR levels of 7.4 to 9.1 dB across the various transponders (3). At CNRs of 8 dB and above

sparklies have been observed only on saturated color bars and these sparklies are not apparent for normal program transmissions. Video SNR should be very close to or above 45 dB at the 8 dB CNR level. Studies by TASO (Television Allocations Study Organization) equate this type of video SNR to a rating of 'Excellent' by 70% of the viewers (tested) and 'fine' by 99.8% of the tested viewers. In 'eyeball terms' this translates to 'some visible grain', inferior by comparison to direct line of sight VHF-UHF reception (4) but 'viewable without annoyance or any sense of loss of detail'. If you are a very critical viewer and/or use a projection television receiver system you may risk some disappointment if the SNR delivered to your receiver is below the 51 dB video SNR routinely supplied by cable operators (5). A 51 dB SNR translates to a CNR of 14 dB and is TASO rated as 'Excellent' by 95% of all tested viewers.

If we are to look ahead to the eventual launch of SATCOM FIV and believe the pre-launch footprints supplied by RCA for their aborted attempt to launch FIII (which one assumes FIV shall replace), we can anticipate a range of EIRPs from 33.7 to 36.7 dBw across the major portions of North America (see figure 6). Similarly, if one is located where the present ANIK-B service is rated as 36 dBw or better (generally speaking north of the 40th north parallel), or is located where COMSTAR or WESTAR footprints are believed to be in the 34-37 dBw region (see CSD for December 1979), one might target 3 CNRs of interest as follows:

- 1) **8dB CNR** = marginal reception (at or just below threshold), lowest cost system
- 2) **11 dB CNR** = standard system margin (i.e. 3 dB built in for system 'aging')
- 3) **14 dB CNR** = highest quality picture (i.e. 51 dB SNR or better, 'studio quality')

Here the system figure of merit (or G/T°) is useful for evaluation of various antenna/LNA combinations. We are, after all, determined to produce the best possible picture(s) within some constraints of budget, antenna-space-available and neighborhood aesthetics.

- 3) **RCA found during the summer of 1979, through tests conducted by COMPUCON, that their EIRP levels for both SATCOM F1 and FII birds were from 1.5 to 3 dB below their anticipated levels with the most severe reductions throughout the eastern U.S.**
- 4) **Line of sight VHF-UHF reception assumes consumer standard receivers and no excess of man-made noise level interference present at or near the off-air receiving site.**
- 5) **Cable operators may in fact attain video SNRs of 51 dB (or better) at their TVRO receiving sites but seldom deliver SNRs in excess of 45 dB to any customers because of cumulative noise and distortion products inherent in any cascaded broadband VHF distribution system.**

$$G/T^\circ = \frac{\text{Antenna Gain}}{\log(\text{effective antenna} + \text{LNA temperature})}$$

From the first calculation example we can see that a 39.3 dB(i) (7) antenna produces a G/T° of 17.6 with a 170 degree ($T^\circ\text{LNA} + T^\circ\text{Ant}$) system noise temperature and a CNR of 10.3 dB results. The 'figure of merit' remains a constant for any given antenna/LNA combination and CNR will track EIRP on a dB for dB basis.

Thus: $G/T^\circ + \text{EIRP} - 43.3 = \text{CNR}$

Now if we can quantify the performance of various antenna sizes as follows we have the makings of a system performance evaluation table:

6 foot aperture = 35.0 dBi
 8 foot aperture = 37.5 dBi
 10 foot aperture = 39.5 dBi
 12 foot aperture = 41.0 dBi

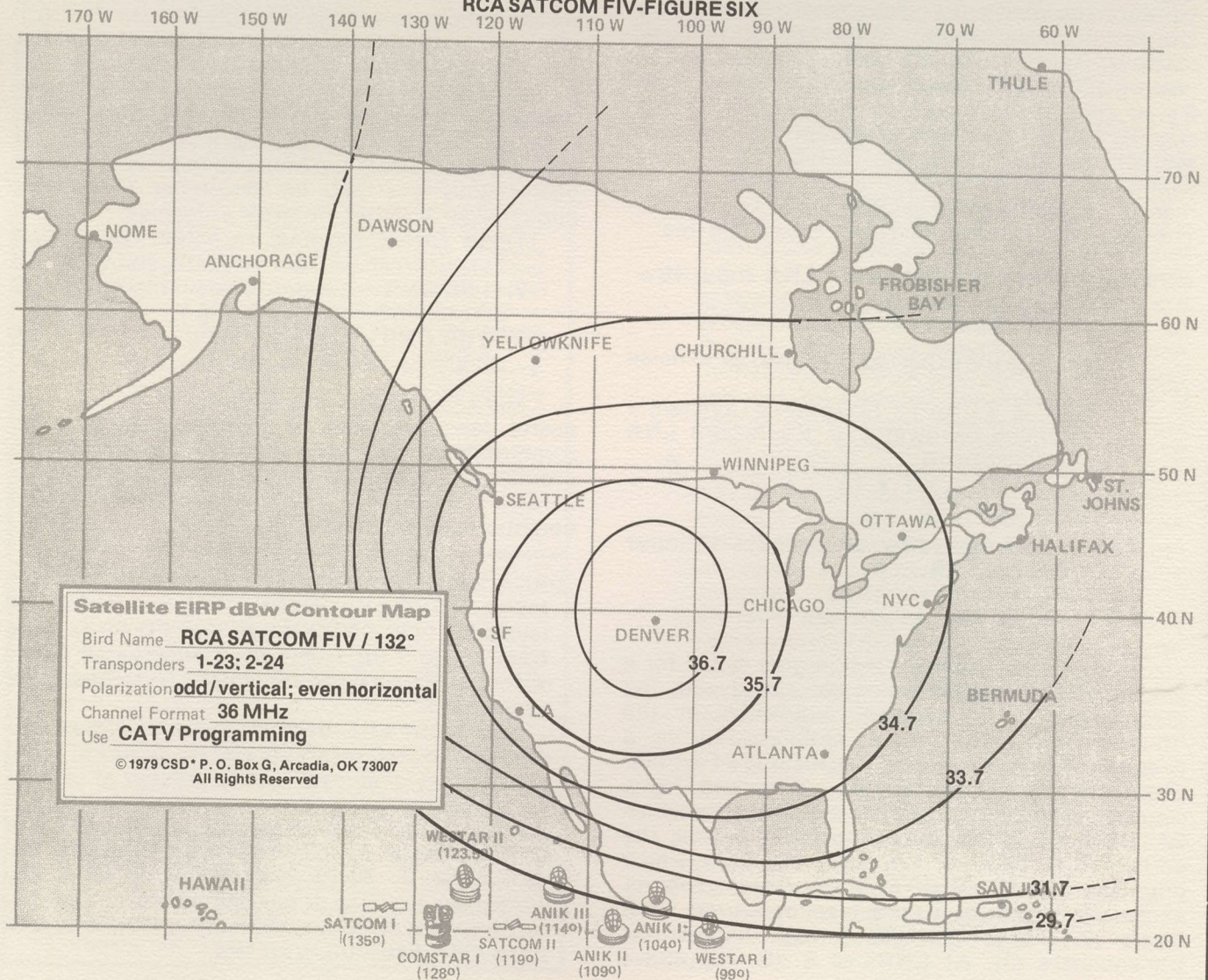
15 foot aperture = 43.0 dBi

20 foot aperture = 45.6 dBi

Knowing then what our antenna gain is (thought to be), knowing what our EIRP signal level is (thought to be), we can then mathematically determine what our system noise temperature (antenna noise temperature **plus** LNA noise temperature) must be to achieve various levels of performance or service.

Antenna Size	EIRP LEVEL	8 dB	11 dB	14 dB
6'	33.7dBw	57.5°**	40.7°**	28.8°**
	34.7dBw	72.4°**	51.2°**	35.5°**
	35.7dBw	91.1°**	64.5°**	44.7°**
	36.7dBw	115°**	81.2°**	56.3°**
8'	33.7dBw	97.7°**	69.1°**	48.8°**
	34.7dBw	123°**	87°**	61.5°**
	35.7dBw	155°	109°**	77.4°**

RCA SATCOM FIV-FIGURES SIX



	36.7dBw	195°	138°*	97.5°**
10'	33.7dBw	155°	110°**	77.4°**
	34.7dBw	195°	138°*	97.4°**
	35.7dBw	246°	174°	123°*
	36.7dBw	309°	219°	154°
12'	33.7dBw	219°	155°	109°**
	34.7dBw	276°	195°	137°
	35.7dBw	347°	246°	173°
	36.7dBw	437°	309°	217°
15'	33.7dBw	345°	245°	173°
	34.7dBw	434°	308°	218°
	35.7dBw	547°	388°	274°
	36.7dBw	688°	489°	345°

Antenna temperature is a function of many factors including the design of the feed, the **type** of feed employed and how it is employed, and the elevation or 'look angle' of the antenna. In the mid-atlantic states north along the eastern seaboard into the Canadian Maritime Provinces, and in the Caribbean east and southeast of Miami, the location of RCA's FI satellite (135 degrees west) produces a very low 'elevation' or look angle for your antenna. As the antenna comes closer and closer to the horizon (i.e. ground) to the west/southwest to boresight upon FI the antenna begins to 'see' the earth itself as a noise source. It is not possible to accurately stipulate the antenna noise temperature for **all antennas** of a specific size for **all locations** but for a common prime focus fed antenna with a look or elevation angle in the 12 degree or lower region the antenna temperature may be approximated as follows:

Antenna Size	Antenna Temperature (degrees Kelvin)
6'	70 degrees
8'	58 degrees
10'	50 degrees
12'	44 degrees
15'	40 degrees

In the midwest and further west (and south) where the elevation/look angle rises simply because the bird is now higher in the sky the antenna temperatures under the above conditions can be approximated as follows:

Antenna Size	Antenna Temperature (degrees Kelvin)
6'	36 degrees
8'	32 degrees
10'	29 degrees
12'	26 degrees
15'	24 degrees

Since our system noise temperature is a composite of the LNA noise temperature and the antenna noise temperature and we can now see that our antenna contribution is largely beyond our control (having been determined by where we live

and the antenna size chosen plus to some small extent the type of feed with the antenna), what about the contribution of the LNA? It would appear that the minimum practical LNA temperature (or noise temperature/factor if you identify with this nomenclature) is in the 85 degree K(elvin) region for the immediate future; and this is available only at a staggering cost (8). We can therefore, in our composite table of antenna sizes vs EIRP levels, eliminate any case where the required **total system temperature** is unattainable in the (north)eastern United States (and the far southeast such as Florida, the Caribbean, Bermuda and the northeastern portions of Canada)...indicated by a **single asterisk (*)**, or, throughout the same area as well **plus** the midwest, south and southwest...indicated by a **double asterisk (**)**.

Clearly the 6 foot size parabolic antenna is unworkable virtually anywhere for a serious viewing system (9). If an absolute minimum size antenna is important (because of neighborhood restrictions, lot size problems, etc.) and cost of the total system is no object (i.e. you are prepared to spend whatever is required for the LNA), the three identified levels of performance could be obtained as follows (**with an 85 degree K LNA**):

Marginal - 8', except 10' in the south and New England

Standard Quality - 10', except 12' in the south and New England

High Quality - 12', except 15' in the south and New England

Since the current 'sweet spot' for cost/performance in commercial LNAs is at the 120 degree K point, an optimum cost fully purchased system might be (**with a 120 degree K LNA**):

Marginal - 8' midwest, 12' south and New England, 10' elsewhere

Standard Quality - 10' midwest, 15' south and New England, 12' elsewhere

High Quality - 12' midwest, 20' south and New England, 15' elsewhere

7) Most [but not all] parabolic antenna suppliers measure the forward gain of their antennas in the maximum lobe as a function of 'gain over and above' an isotropic source (i.e. i). An isotropic source is a mathematical 'reference antenna' that does not exist in the real world; generally it is said to have 2.1 dB less gain than a simple dipole mounted in 'free' space. References here are in dBi; antennas referenced to a dipole would be in dBd (d indicating gain above a reference dipole in free space).

8) While prices change rapidly in the commercial LNA field, an 85 degree 'guaranteed' LNA is typically in excess of \$5,500.

9) An exception might be reception from Canada's ANIK-B on 4 GHz in central Canada where an EIRP of 38 to 39 dBw is quoted by Telesat Canada.

If you have acquired this manual with the serious intent of constructing your own TVRO terminal electronics (including the LNA) you might be wondering what you can expect with a bi-polar type (HXTR 6101) LNA of your own construction married to the receiver described here:

With a homebrew **275 degree K LNA...**

Marginal - 15' south and east, 12' others

Standard Quality - 20' south and east, 15 foot elsewhere

High Quality - 15' in midwest only around boresight (see figure 6), 20 foot elsewhere except south and east; not practical there.

Those considering use of the Swan Spherical or other sizes of antennas can readily make the same comparisons by appropriately substituting the gain of the proposed antenna and the effective noise temperature of the antenna in the above calculations. (10)

At this point one can determine the best trade off(s) in cost, performance and mechanical problems associated with antenna size (mounting, foundations, wind loading, etc.) and reach some logical conclusions about how your own system will go together.

HOW MUCH LNA GAIN DO I NEED?

The Washburn TVRO Receiver provides a fairly typical noise figure of 13 dB. What does this mean? Simply that an input signal will have added to it noise at a level 13 dB above thermal (which is usually assumed to be 290 degrees Kelvin), or 5800 degrees K. Note however that at the same point the effective noise temperature of the antenna will have been **amplified** by the LNA gain, minus feedline (LNA to receiver) losses. In a complete system, therefore, the 'true' antenna noise temperature is actually:

T° Overall =

$$T^{\circ} \text{LNA} + T^{\circ} \text{Ant} + \left(\frac{T^{\circ} \text{Receiver}}{\log^{-1}(\text{G-LNA} + \text{Feedline loss})} \right)$$

Clearly, since LNA temperature reduction below the 'sweet point' is so expensive and bulk LNA gain less so, it would be imprudent to allow the receiver to add more than perhaps 5% (preferably 1%) to the overall system temperature. With the assumptions of the standard margin (11 dB CNR where 8 dB CNR is considered to be the FM threshold for visible sparklie noise) and an eastern or southern location (where one wants to give up little in system temperature because of antenna noise contribu-

10) The real-world noise temperature of a Swan Spherical TVRO Antenna is a subject for some debate at the present time. It is probably higher than an equivalent sized parabolic for low look angles.

tions which cannot be avoided with smaller sized antennas), the minimum net gain from antenna input to receiver input for typical LNA noise temperatures would be:

LNA T°	5% Overall Degradation	1% Degradation
85	29.3 dB Gain	36.3 dB Gain
100	29.1 dB Gain	36.1 dB Gain
120	28.5 dB Gain	34.1 dB Gain
180	27.1 dB Gain	34.1 dB Gain
275	25.7 dB Gain	32.7 dB Gain

If you select a standard **commercial LNA** with **50 dB plus of gain** (55 dBg typical) you will be in an overkill situation for nearly any feedline and should seriously consider either RG-214 at -23.5 dB per 100 feet (therefore with a commercial LNA good for up to approximately 80 foot runs) or for short runs RG-223 at -43.5 dB per 100 feet (therefore useable for a run to approximately 40'). Why throw dBs away? Because excess gain will do you no good and may even require a receiver input pad with the higher EIRPs and larger antennas (see Down-converter Theory and Operation, in this manual).

"Designed for private" and home-brew LNAs should be chosen to allow a minimum of 25 to 30 dB gain (dBg); with noise temperatures of 275 to 85 degrees K respectively, at the receiver input, both for the overall noise considerations discussed here and to insure adequate signal to the video detector in the receiver proper.

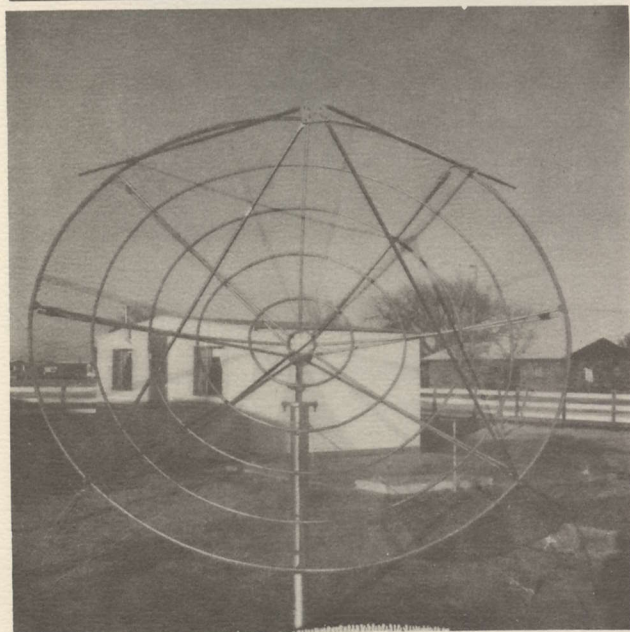
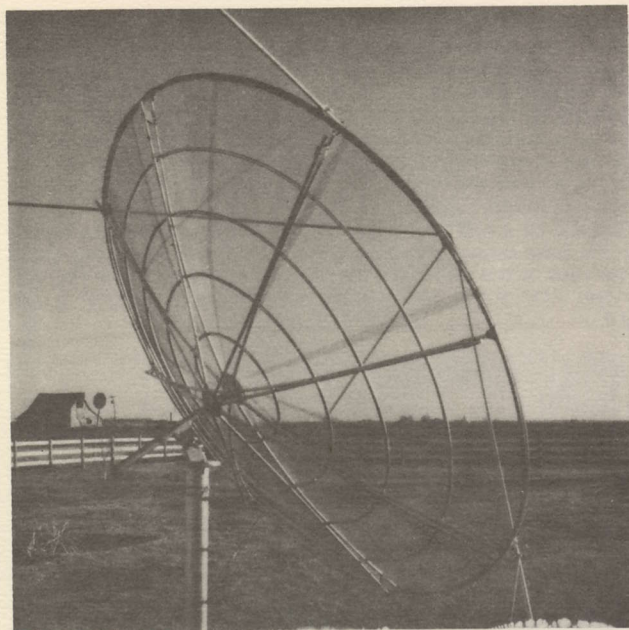
REPORT ON HOMEBREW

TVRO ANTENNAS

SPRINGING UP ALL OVER

Apparently not everyone feels handicapped by not being able to walk into the nearest Radio Shack and head home with an inexpensive satellite TV antenna. We've been collecting photographs of home construction (or home installed as in found-in-surplus and brought home for re-conditioning) of various types of designs of home TVRO antennas for several months now. And the file is overflowing. Here is what a **few** of the pioneers are doing for antennas these days.

James Burkett of Breckinridge, Oklahoma built up a 10 foot reflector surface with a 60 inch (f/D of .5) focal length. Depth of the dish is 15 inches. The materials are 1/2 inch conduit covered with 1/8th inch hardware cloth. Other materials included (2) 4 inch floor flanges, a 5-inch (1-1/4) nipple and a pair of 6 inch by 1/4 aluminum plates. The parabolic shape was

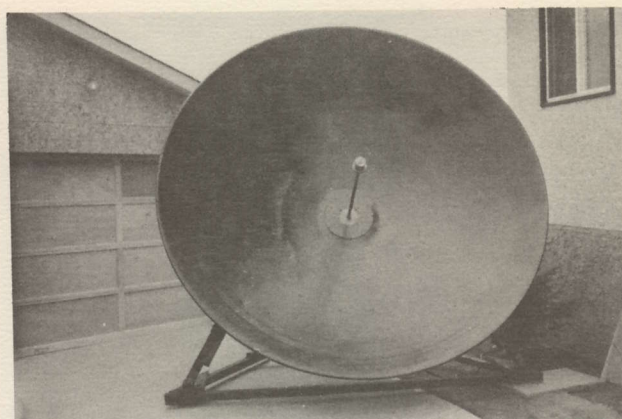


Jack Burkett's home brew conduit-rib 10 footer

laid out with 6 inch squares on a piece of plywood and the half inch conduit was bent to fit the parabolic shape on the plywood with a conduit bender. The outer circle seen in the photos has a pair of half inch conduit pieces bolted together with 8:32 hardware. The 1/8th inch hardware cloth is first tied in the center and the outer edge and then pulled down tight to each inner circle with #16 wire every six inches. The mount is constructed from 4 inch oil field casing pipe, 9 feet long. Inside of this is a two inch pipe that turns in 3/8 inch steel 'doughnut holes' welded at the top and bottom.

Ingenious and low cost.

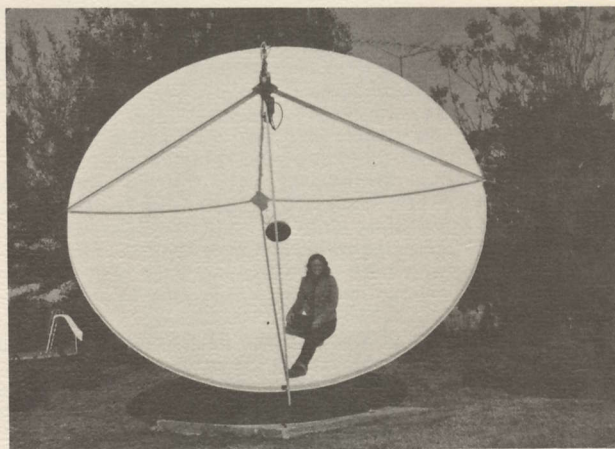
Rene A. Matthijssen (RR #1, P. O. Box 576, Marinville, Alberta TOG /PO Canada) went home from SPTS '79 in Oklahoma where he reports "I learned a lot". He has rounded up some surplus WR-229 waveguide to go with his surplus dish (see photo here) and he is willing to share the waveguide with others (we assume Canadians only should contact Rene since



Rene Matthijssen's surplus dish and homebrew mount

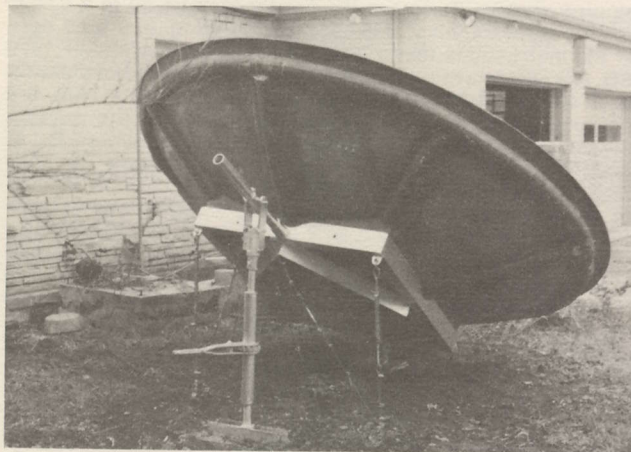
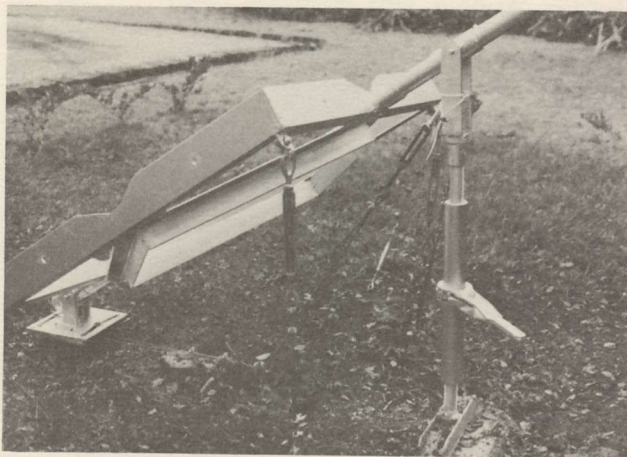
shipping waveguide across the border may be quite a hassle with the customs folks). He suggests building up a feed horn per the instructions found on page T8 of the November 1979 CSD. His antenna mount is simple but effective as the close up photo shows. Rene also notes that "surplus antennas are getting very scarce here undoubtedly due to the sudden interest in TVROs by hundreds if not thousands of Canadians". Send us some **construction details** of your WR-229 conversion to feedhorns Rene!

A couple of months ago a young couple from eastern Oklahoma dropped into the STT Lab Site in the midst of an unseasonable fall thunderstorm looking for information about construction of a satellite home system. Jack and Melissa are in the fiberglass boat business and they live in an area where they receive only a single television station. Jack felt that if he could mold fiberglass boat hulls he could also put together a fiberglass TVRO antenna. We encouraged him to try and less than five weeks later the photo here was taken. That's Melissa with the dish which looks like a dandy 15 footer. In fact Scientific Atlanta had better watch out if Jack ever tires of the boat business!



Melissa with the dish Jack built

If all of this talk of home brewing your own antenna has you intrigued, you might want to investigate a couple of relatively low cost commercial antennas which are now being produced in the southern midwest. **Randel Odom** (Route 1, Box 347, Beebe, Arkansas 72012; 501-882-5756) has a ten foot reflector surface molded out of fiberglass which he sells for \$850 FOB Beebe. In the two photos here we see this antenna installed at the home receiving site of Lindsey Riddle of New Orleans. Lindsey used a length of airplane cable with turnbuckles on a 'steamboat ratchet' because he had some



Randel Odom's ten footer installed in New Orleans

'play' in the screws. He found the rachet for \$25 in a junk yard in New Orleans and reports several more are available at the same place. In the second photo we see the Odom ten foot dish mounted on Lindsey's homebrew mount.

Another antenna now being manufactured and sold in the same area is the 10 foot parabolic reflector that is built in quarter sections by **Mini-Casat** (2107 Forrest, Tupelo, MS 38801; 601-842-8617). The price is \$520 FOB Tupelo and the antenna does not include a mount nor a feed. Construction is with fiberglass sandwiching screen wire and the antenna does have flanges on the back for attaching your own mounting system. Present production capacity is around 15 antennas per month.

With the death of **Oliver Swan** on Christmas eve many have asked what will happen with the various agreements and production facilities set up to produce the Swan Spherical TVRO Antenna. As most readers know, Oliver developed the antenna over an extended period of time (see **CSD** for November 1979, page P2) and had authorized his brother Henry to produce the antennas commercially from a facility established in Stockton, California (**Swan Antenna Co.**, 2202 Hollywood Drive, Stockton, CA 95210; 209-948-5254). Oliver had also reached agreement with Cliff Gardiner of Gardiner Communications Corporation to produce the antennas for the cable and commercial markets although Henry Swan advises us that as of early January the final format of the Gardiner agreement had not been reduced to paper for both sides to sign. The assumption at this point is that Gardiner will be moving ahead with a commercial version of this innovative antenna.

Henry Swan meanwhile continues to produce the Swan Spherical type antenna in two formats. A 14 foot version which

includes mounting brackets and the feed horn created by Oliver sells for \$3100 list price FOB Stockton. A five meter (roughly 16.25' aperture) sells for \$3600 list price. Both are FOB the Stockton plant and there are some dealer discounts available for **legitimate** installing dealers. Henry Swan will be spending considerable time in Bisbee for the next few weeks attempting to straighten out the cable systems owned by Oliver and his wife at the time of Oliver's death. He asks that those who have made query about being licensed to build the Swan Spherical on a regional basis hold off recontacting the family for the time being. If you are interested in purchasing small quantities of the antennas for personal or resale use you can contact Alan Swan at the Stockton telephone number given here.



Gene Marygold and his shrouded dish

And finally for this report here is one man's approach to shielding his prime focus fed antenna in what must be a high signal area for interfering signal sources in the 3.7 to 4.2 GHz region. That's **Gene Marygold** with his rotor equipped feed working on his newly installed dish at his Vista, California location. In commercial installations 'shrouding' such as you see around Gene's dish is fairly commonly employed to insure that stray signals coming at the feed from side angles do not get into the system. We'll have a report on designing and building your own shroud in a subsequent issue of **CSD**.

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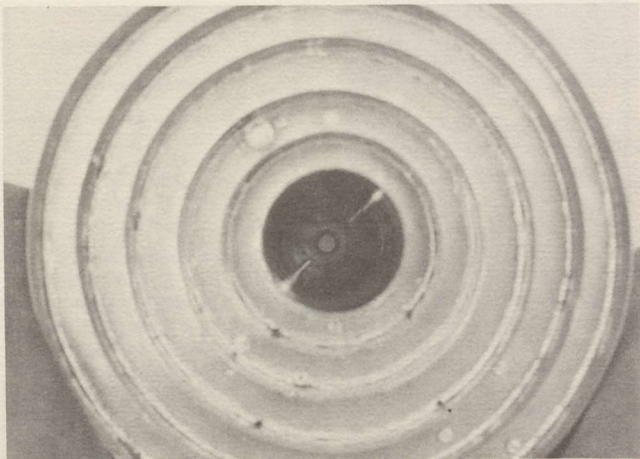
SMALL TERMINAL ANTENNA NOTES

BIRKILL HYBRID MODE RE-VISITED

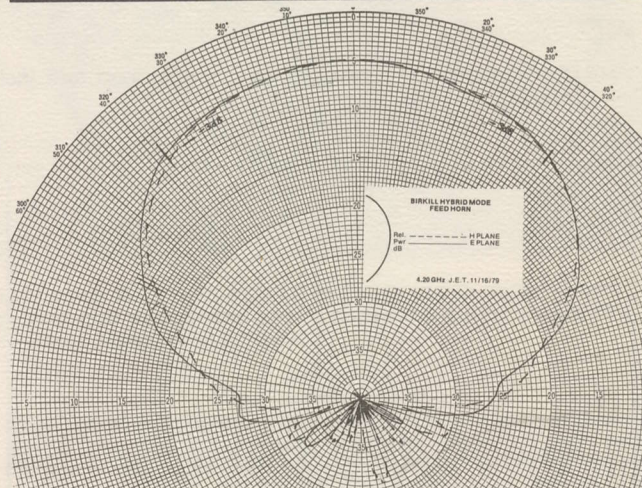
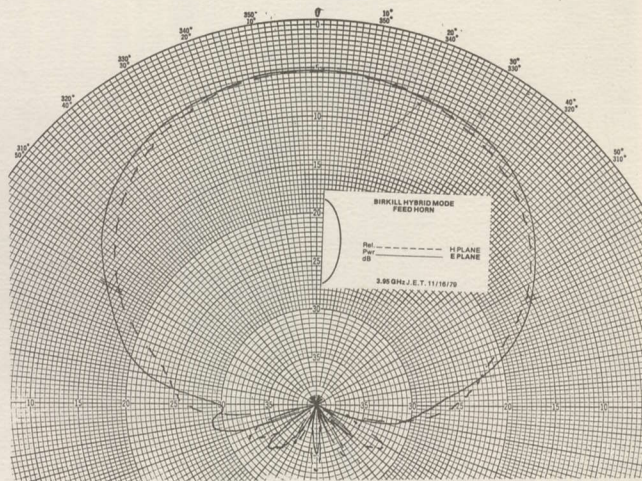
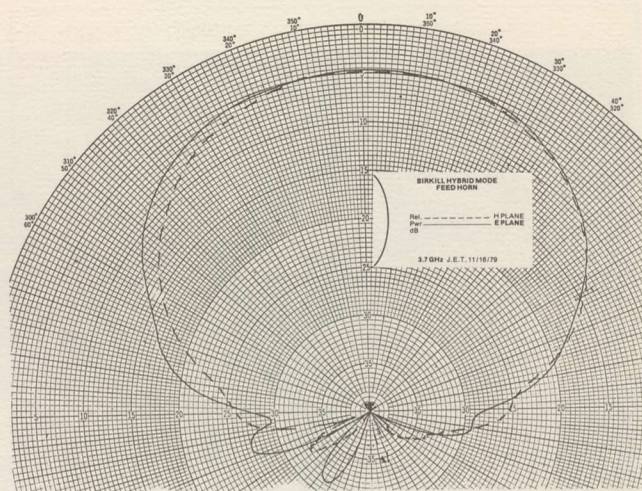
With interest in experimental reception from INTELSAT or STATIONAR satellites growing, it may be time to re-visit the Birkill 'Hybrid Mode Feed' originally described in the February 1979 issue of CATJ Magazine [*]. Small system enthusiast Jack Trollmann of Mountain View, California recently constructed the Birkill feed and with the equipment available to measure the effective pattern of the feed he provides the following data:

The radiation patterns for the Birkill feed were measured at 3.7, 3.95 and 4.2 GHz. E plane is shown on the solid trace while H plane is shown on the horizontal trace.

- 1) The E and H plane beamwidths are nearly identical for all three frequencies. This is desirable since it results in a uniform illumination of the reflector surface which in turn maximizes the aperture efficiency.
- 2) The patterns remain uniform across the band. While only three points were actually measured it is very unlikely that any noticeable deviations from the three patterns would take place.
- 3) From the feed horn design curves in Jasik [**] the optimum f/D ratio this feed should be used with is 0.47. This is based on a -10 dB edge (of reflector surface) illumination for maximum gain and includes the space attenuation effect resulting from the edge of the reflector being further from the feed horn than the surface directly in front of the horn. This value of f/D is the center of a rather flat efficiency curve so the feed can be used with other ratios with only tenths of a dB sacrifices in G/T .

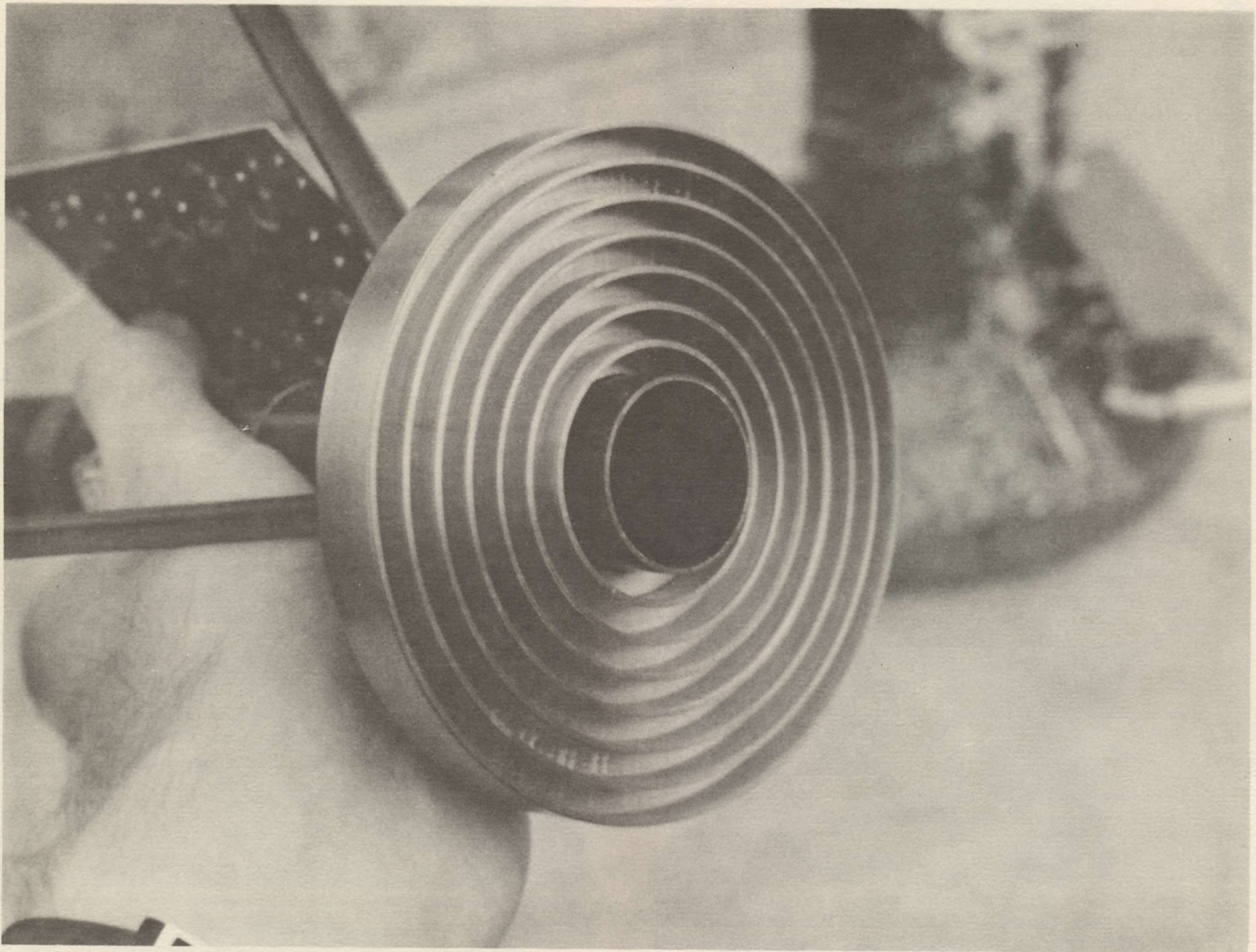


BIRKILL HYBRID/CORRUGATED FEED head on. Thin brass sheet, 7/8ths inch 'tall', form the circular 'walls' that circumference the base plate. Birkill utilized a 9 inch disc of double sided copper clad PC board material for his rear plate.

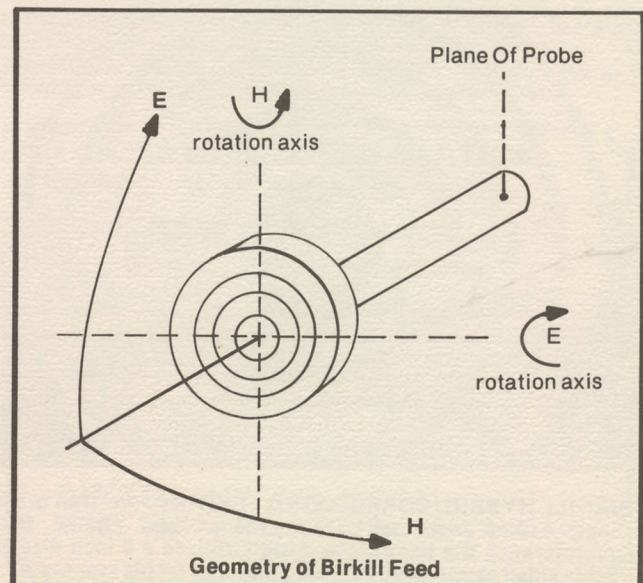
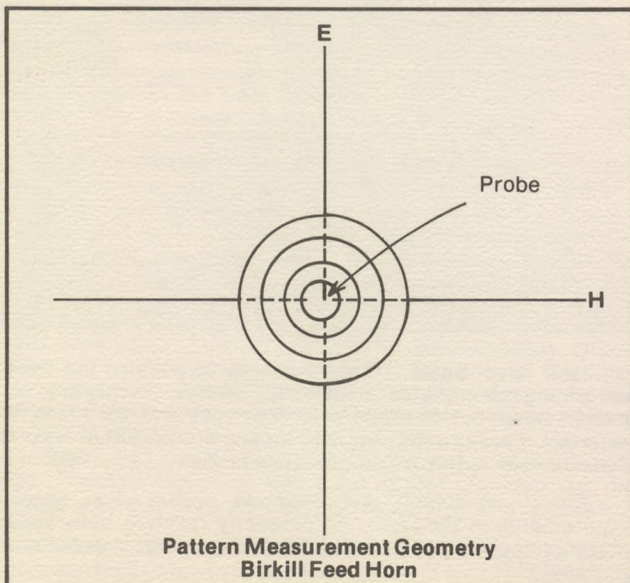


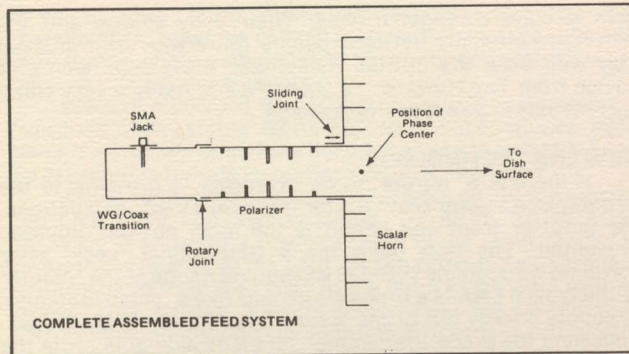
Jack also notes "This horn is probably the best performing per unit of construction difficulty currently around. It took me about five hours to construct and \$8 worth of materials." Jack continues other testing on the Birkill Hybrid Mode Feed including VSWR measurements.

Birkill developed the feed to satisfy his special requirements in the U.K.; he presently receives both linear and circular polarized signals from domestic and international grade satellites.

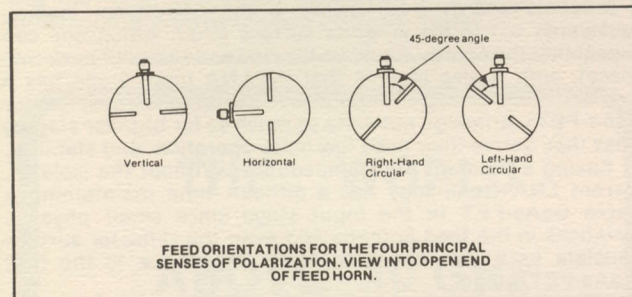


CORRUGATED FEED mounts on a sliding joint to 2 inch waveguide section and adjusts for proper 'phase center' [see diagrams].

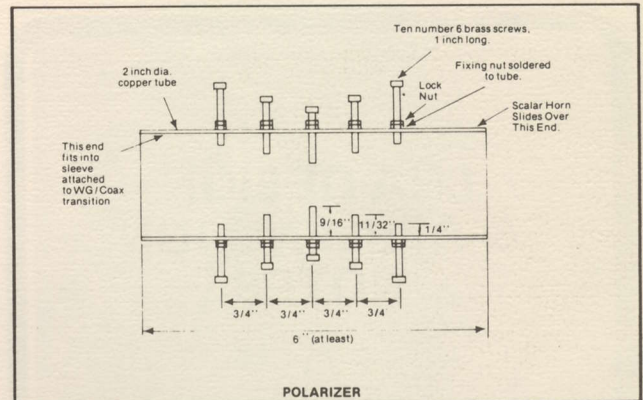




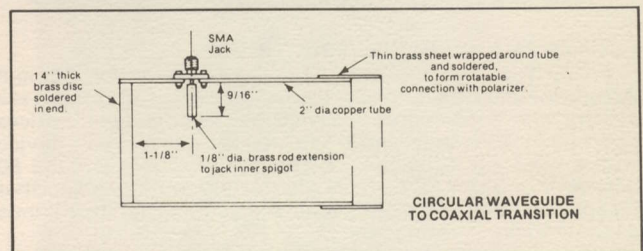
COMPLETE ASSEMBLED FEED SYSTEM



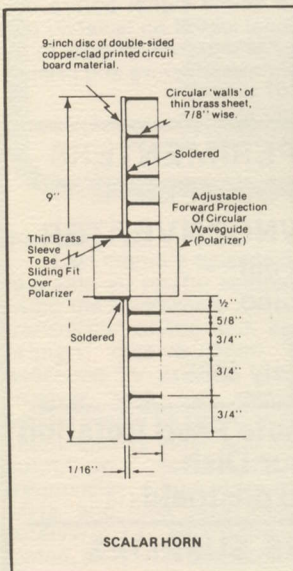
FEED ORIENTATIONS FOR THE FOUR PRINCIPAL SENSES OF POLARIZATION. VIEW INTO OPEN END OF FEED HORN.



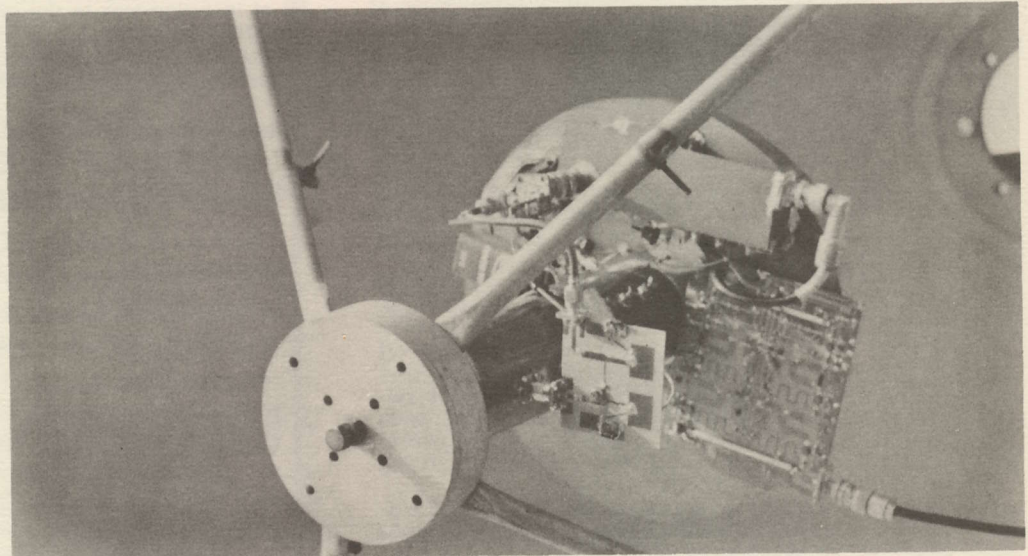
POLARIZER



CIRCULAR WAVEGUIDE TO COAXIAL TRANSITION



SCALAR HORN



REAR OF BIRKILL FEED houses, in his case, the 4 GHz, high LO and UHF region receiver i.f. electronics. Two inch diameter copper tube 'waveguide' can be slid in and out for maximizing the focal point position of the feed reference the reflector surface.

The antenna consists of a scalar horn with a sleeve that attaches to a 2 inch diameter copper tube which acts as a section of circular waveguide. The copper tubing/waveguide is outfitted with a quantity number 6 brass screws which are positioned as indicated here to form an adjustable polarizer. The polarizer when properly adjusted introduces a 90 degree (differential) phase shift between horizontally and vertically polarized waves. When we have a plane (i.e. non-circular) polarized wave passing through the polarizer at 45 degrees, it is converted to a circularly polarized wave with the 'sense' of rotation depending upon the direction the initial 45 degree rotation is applied (see diagram). In a similar fashion, circular polarization is converted to plane or linear polarization. For a given orientation of the polarization two sense of circular

polarization will create either horizontal or vertical polarization out of the polarizer. An orthogonol mode coupler (see diagram) will allow you to recover both sense of plane polarization simultaneously. If you don't require both senses simultaneously a rotating joint on the circular waveguide will enable you to select either one or the other.

* - CATJ Magazine no longer makes copies of past articles available. An updated set of construction sketches for the Hybrid Mode Feed appears here.

** - See "Antenna Engineering Handbook" by Henry Jasik [McGraw-Hill Book Company, New York; First Edition [1961], pages 12-5 and 12-6.

LNA DESIGN & APPLICATION NOTES

GaAs-FET HANDLING INSTRUCTIONS

One year ago the non-commercial market for Gallium Arsenide Field Effect transistors did not exist. Today there are sources where 150 degree K devices can be obtained for prices in the under \$50 region and \$75 to \$100 will buy for you a device with a noise figure in the 1 dB region at 4 GHz (around 80 degrees K). GaAs-FET prices are starting to tumble and that means that more and more people are going to get their hands on these tricky little buggers.

Several words of caution about touching, handling, using, poking or showing off these little gems are in order. Even at \$50 a piece you don't want to blow up any by careless handling or improper installation techniques.

- 1) **GaAs-FETs are extremely brittle** and must be handled with extreme care to avoid chipping, cracking or physical damage (i.e. breakage).
- 2) **When you pick up a GaAs-FET**, the picker-upper (as well as any tweezers or other pick-up tool) should be grounded to the test, assembly or inspection area. This prevents the build-up of a static charge (in the gate area of the GaAs-FET) which can damage the transistor if allowed to pass through the device.
- 3) **Spurious pulses or spikes or transients** generated by test equipment (such as 'contact bounce' during switching, induced voltage in the leads and so on) cannot be tolerated by the device. Avoid turning the power on and off on the test equipment **or switching between ranges** with measurement equipment (i.e. switching from one voltage range to another with the test gear) **while** the leads are attached to the GaAs-FET. Switch to safety by first disconnecting the test instrument (even digital VOM) from the circuit **before** changing ranges.
- 4) **Use shielded power wiring cables** and shielded RF signal coupling cables. Inductive pick-up from (switching) power supplies and so on cannot be allowed to get into the leads going to the GaAs-FET.
- 5) **GaAs-FETs are light sensitive** (!). A bright light shining on the GaAs-FET while you are making (any) measurements will change the characteristics of the device from what they will be when the unit is bottled up inside of a container. There is no hazard here (to the safety of the device); only a warning about measurements.
- 6) **A GaAs-FET does not like moisture**. Excessive (read any visible or apparent) moisture on a GaAs-FET when normal operating voltage is applied will probably cause the device to go west quickly. A long ways west...
- 7) **Placing bias on the GaAs-FET** must be done in a prescribed pattern. **First** apply the gate voltage and **then** the drain voltage. When removing bias take away the gate voltage **last**.

This set of caveats should (logic suggests) apply to all GaAs-FETs. However they probably do not. Therefore as we become aware of different handling and use precautions for different GaAs-FET devices we will pass them along to you.

The bottom line is don't open up the small plastic container with a GaAs-FET inside and pass the tiny 'piece of

gold' around amongst friends. Their body charge and the different potentials between people (plus your own charge) may well blow the device. Remember these sage words of advice from Tay Howard: "a GaAs-FET is really a very small current fuse in an expensive package..."

NEW LNA TECHNOLOGY

If there is a 'hurdle' to be overcome in bringing to the marketplace a lower cost LNA for (private) TVRO installations, the input or front end circuit is the most obvious impasse presented. The first thing the 4 GHz signal 'sees' after traveling through the WR-229 waveguide flange at the 'mouth' of the typical LNA is a probe which acts like a 'small antenna' to couple energy out of the waveguide into the LNA proper. Following the probe the commercial LNAs available route the signal through a device known as an isolator. The isolator has several functions in life; it is kind of like a one-way street in that it prevents energy from inside of the LNA from leaking **backwards** out to the antenna surface (from which one can expect that the energy would be focused and radiated back into space), and, it also insures that the LNA input stage has a constant 'load' or source impedance. The latter is important for GaAs-FETs (although not quite so much so for bi-polar stages) since they derive their good low noise operation, and stability, by having a constant input impedance. Without the isolator, current LNA technology has a difficult time maintaining a stable GaAs-FET in the input stage since small physical variations in the feed antenna and even the reflector surface translate back to a changing input impedance to the first (GaAs-FET) stage.

Yet eliminating the isolator (which **also** adds from .15 to .2 dB of insertion loss to the inward bound signal before it is amplified) is desirable. The additional loss of an isolator, plus the expense of the high quality ferrite material internal to the device extracts a toll on LNA design, manufacture and pricing.

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Even in very large quantities isolators cost the LNA manufacturer upwards of \$100 each and when a manufacturer pays that much for a single 'part' the multiplied cost of the LNA becomes considerably greater.

Work to eliminate the isolator while still maintaining an 'unconditionally stable' GaAs-FET front end continues. When there is a breakthrough here the price on commercial LNAs can be expected to tumble by perhaps 25-30% overnight.

At the same time developmental work on other aspects of the LNA front end also continue. At SPTS '80 in Miami DEXCEL is showing a new approach to the input probe; the probe in the new DEXCEL LNA is grounded and signal energy is transferred from the probe to the input stage via a coupling device. This 'air-gap' transfer should make the new DEXCEL LNAs almost impervious to lightning strikes (present or other probe structures are floated above ground). Anyone who has lost an LNA to lightning that often couples into the amplifier via the input probe can appreciate this added degree of protection offered by the new DEXCEL design.

THE WORLD ABOVE 10 GHz

by
Robert M. Richardson
Richcraft Engineering Ltd.
Drawer 1065
Chautauqua, N.Y. 14722
[716]753-2654

Summary

Last month's episode described how absurdly simple it is to create an fm/fm composite video-audio signal at 10 GHz using the Microwave Associates' Gunnplexer as the primary transmitter source with another Gunnplexer module as the primary receiver/down converter driving an ordinary wideband TV preamp feeding a **standard** am/fm television receiver **with no signal conditioning or modification whatsoever**. The secret to making this system work and deliver studio quality video and audio is to have the Gunnplexer i.f. output on one of the standard VHF TV video carrier frequencies, adjust video deviation to somewhat less than 4.5 MHz, and then slope detect the video signal with the TV receiver's i.f. amplifiers. Six different TV receivers were tested, all with superb results.

Correspondence

Dear Bob: I found the FM-TV part of your column very interesting in the December '79 issue of "Coop's Satellite Digest." I tried the experiment using an fm modulator module from an RCA broadcast video tape machine and heterodyned the signal to the color TV i.f. frequency. You are right, it works very well and makes good color too. The color TV i.f. makes a very good slope detector for fm signals of about 2 MHz bandwidth. The i.f. bandpass is the typical "haystack" shape to achieve linear phase response. The slopes on each side are quite linear and either side will work equally well depending on the direction of the fm modulation. If you are on the wrong side the video will be negative.

Thanks for "discovering" the Richardson effect. It will sure make it easier to build some microwave TV links. See you on the Sunday 20 meter net at 14.311 MHz - 1300 CST.

Jim Keeth, AF9A
Indianapolis, Indiana 46260

Ed.: Many thanks for the kind words, Jim...and in color too!

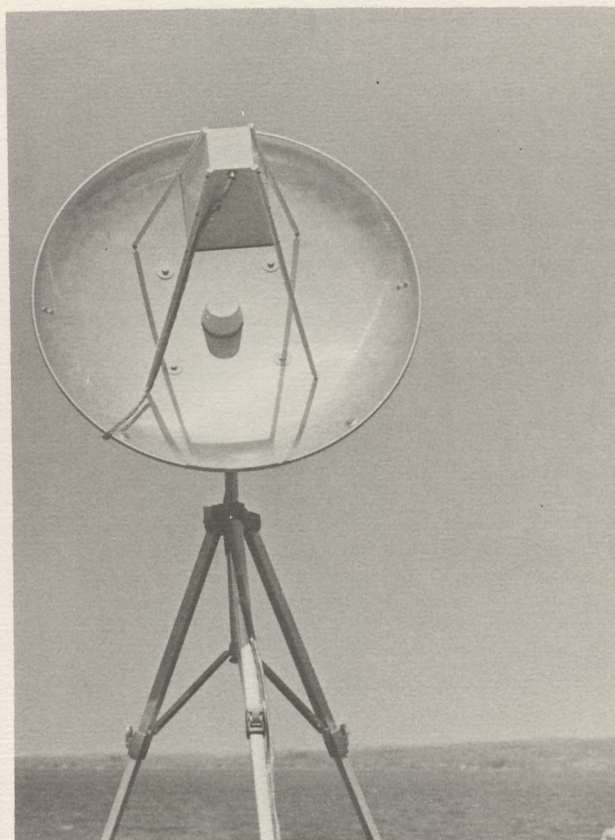


FIGURE ONE

Gunnplexer [GPX] frequency stabilization and repeatability

There are fundamentally 5 parameters that affect GPX frequency stability and repeatability.

- 1) **Gunn diode bias** (bias means power supply of nominally +10 Vdc at 500 mA). Varying the bias is called "frequency pushing" and changes the output frequency on the order of 10 MHz per volt. Hence we use a stable & pure dc well regulated supply.
- 2) **GPX varactor voltage**, adjustable from +1 to +20 Vdc. This allows us to electronically "tune" the Gunn diode over a range of approximately 80 to 100 MHz.
- 3) **Mechanical rigidity** of the GPX module with respect to nearby reflecting objects, such as the parabolic reflector shown in Figure 1.
- 4) **Gunn diode & varactor diode aging**. This is insignificant and somewhat similar to crystal aging.
- 5) **Temperature stability of Gunn diode**, varactor diode, and their surrounding machined brass cavity. Typical frequency change per-degree-F variation of this cavity is approximately 150 kHz. This is not a whole bunch, but when one considers that 10 degrees F = 1.5 MHz, this would require that the TV set's fine tuning be re-adjusted which is an inconvenience and not acceptable to the average TV viewer. **Let's simply fix it.**

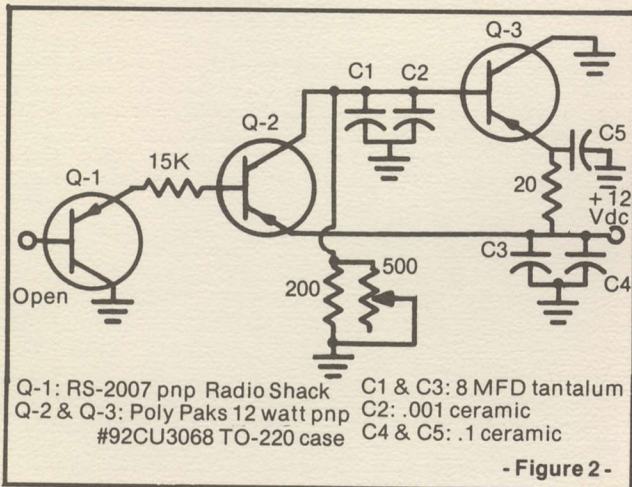
Assuming we have well regulated ripple-free dc power supplied to the Gunn diode and varactor diode, plus a reasonably rigid GPX module mount with respect to its parabolic reflector as illustrated in **figure 1**, the easiest way to achieve GPX frequency stability and repeatability is via proportional temperature control. This sounds horrendously difficult and complicated to most would be microwave buffs, when it actually is one of the simplest and easiest tasks to build, test, and operate. Parts cost is less than \$5.00, plus a 1 mA millimeter, and if the following step-by-step instructions are followed, will give you **better than 1/100th degree F temperature stabilization**, and just as important, frequency repeatability (turn-off & turn-on).

4 GHz Howard/Coleman Terminal VTO

The exact same proportional temperature control (PTC) circuit may be used to temperature stabilize the Avantek 8360 VTO in your Howard/Coleman terminal, if desired. Let's continue while remembering the dual applications of PTC.

Proportional Temperature Control

Is nothing more than a simple **servo loop** consisting of an open-base Radio Shack #RS-2007 PNP germanium transistor acting as a temperature sensor, a small 1/4 watt 500 ohm potentiometer to adjust the temperature desired, and 2 Poly Paks 12 watt PNP transistors. The first Poly Paks transistor serves as a dc amplifier driving the second Poly Paks transistor which acts as the heating element. To operate properly, Q-2 and Q-3 should be of the same type. The schematic for this simple circuit is illustrated in **figure 2**.



Transistor Q-1 functions as an excellent thermistor (a resistor whose resistance varies with temperature) over the range of 75 to 130 degrees F. It is epoxied to the side of the Gunn diode cavity "on-top-of" a thin sheet of tissue paper, as some of the RS-2007 transistors have the base lead internally grounded to the TO-5 case. **Figure 3** shows the GPX Gunn diode cavity, the rectangular protrusion, at the very top of the photo.

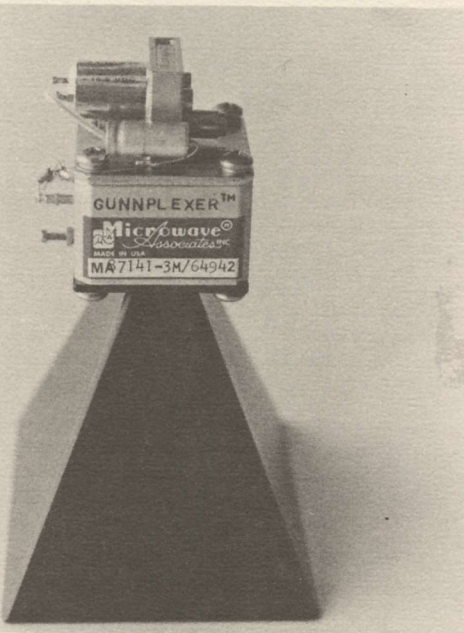
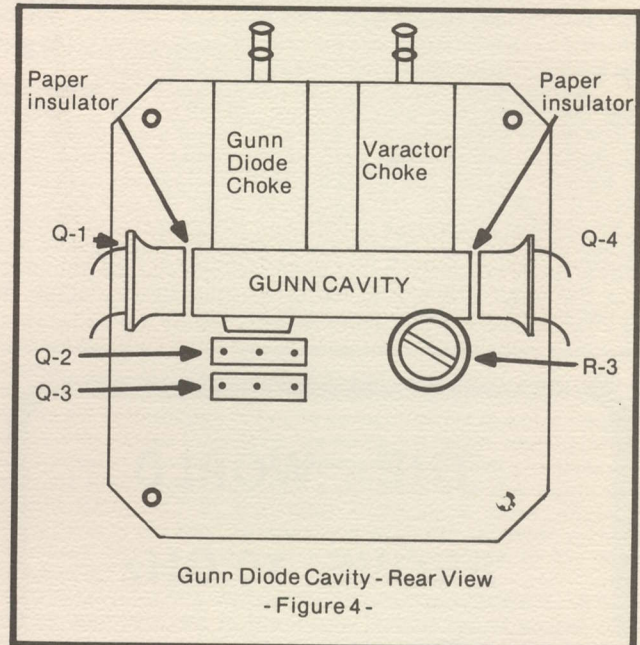


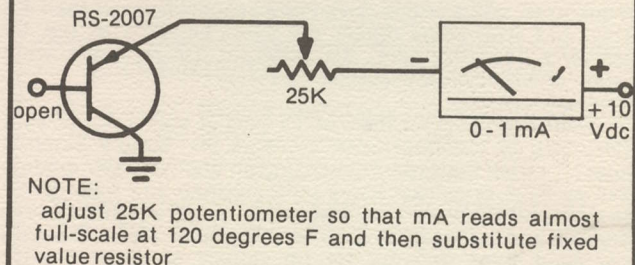
FIGURE THREE

Both the Gunn diode and varactor diode (each only about 1/8" by 1/8" long), are in the center of the Gunn diode cavity shown in the rear end view in **figure 4**.



The two upper cylindrical tubes are 1/4 wave RF chokes for the Gunn and varactor diodes' dc feeds. The RS-2007 temperature sensing transistor is shown on the left of the Gunn diode cavity and another identical transistor is epoxied to the right side of the cavity. Why two sensor transistors? The second one is used as the sensor for our homebrew electronic thermometer which allows us to remotely monitor the temperature of the Gunn diode cavity. Electronic thermometer? Why complicate things? Not exactly; it requires only the RS-2007, a resistor, a 1 mA milliammeter and +10 Vdc regulated which we already have for the +10 Vdc at 500 mA Gunn diode supply. **Figure 5** illustrates this utterly simple but very accurate electronic thermometer circuit.

W4UCH Electronic Thermometer
- Figure 5 -



The remote electronic thermometer's 1 mA milliammeter scale is calibrated using an ordinary glass thermometer and a glass of hot water. The TO-5 can of transistor Q-1 is "just" barely immersed in the hot water. As it cools, mark off the temperature scale as illustrated in **figure 6**. Two degree increments are adequate on a 5" meter face over the range of 90 to 120 degrees F.

Let's review figure 4 for a moment. The two protruding nibs on the bottom of the Gunn diode cavity are of interest to us. The one beneath the Gunn diode should be filed clean to bare brass and then lightly tinned with solder using a 50 watt

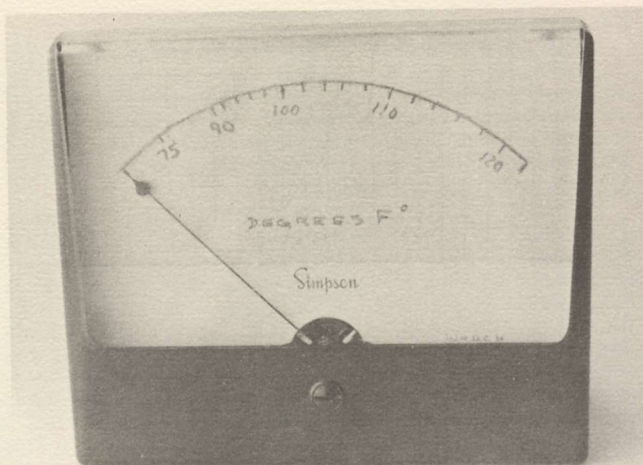


FIGURE SIX

Ungar soldering pencil. Also file and lightly tin the copper heat sink of transistor Q-3 on both sides. Now, quickly solder Q-3's heat sink to the nib beneath the Gunn diode on the bottom of the Gunn diode cavity. Q-3's emitter, base and collector leads should be facing **away** from the cavity housing. Bend Q-1's leads down 90 degrees, and solder appropriately to Q-2's leads that are bent **up** 90 degrees. Q-2 should be spaced about 1/8" from and directly beneath Q-3. Only Q-2's leads support it. The 500 ohm mini-potentiometer, 1/4 to 1/2 watt, is supported by the soldered junction of Q-2's collector and Q-3's base on one side, and a stiff piece of #16 bus bar wire from the case to its center terminal. Though difficult to see at the top of Figure 7, the 500 ohm mini-pot faces straight **up**, so that a small screwdriver can be used to adjust it from the rear when fitted into the mylar covered balsa/plywood case.

Figure 2's ceramic disc and tantalum bypass capacitors are an absolute **must** to eliminate both very low and very high frequency parasitic oscillations. **Note:** The circuit will not operate without them. The wide-band TV preamplifier can be seen on the left side of the GPX module in **figure 7**. Figure 7's waterproof case, to the left of the GPX module, is also shown in **figure 1** where it is supported on 3/8" diameter hardwood dowels at the focal point 14-1/8" spacing from the face of the GPX horn to the center of the dish), of the 25" diameter aluminum Snowled parabolic dish (\$8. from Sears Roebuck).

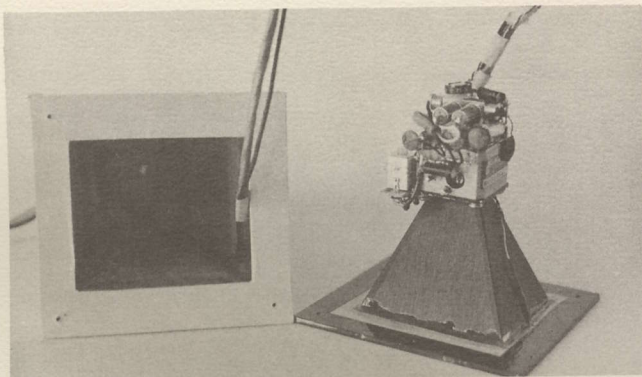


FIGURE SEVEN

How does it work

Quite simply, thank you. It is about as fundamental a feedback servo loop as may be constructed. The feedback is of course the heat transmitted from Q-3's heat sink through about 3/16" of brass to the temperature sensor, Q-1. The concept for this design was described in the January '70 issue of **Ham Radio** magazine, pp 44-46, for a small crystal oven. If simplicity is the epitome of good engineering, this has got to be a winner.

The base of Q-1, a germanium PNP transistor is left

floating. Its collector current will increase about 10 times from 75 to 130 degrees F. As its collector current increases the forward bias to Q-2 and Q-3 decreases, thus reducing the amount of heat generated by Q-3. Depending on the setting of the 500 ohm potentiometer, and the heat overflow, a point of equilibrium will be reached where temperature stabilization will occur (as much as 1/100th degree F in a well insulated draft-free enclosure). We chose 120 degrees F as the optimum temperature for the Gunn diode cavity for a number of reasons. The nominal Gunn diode cavity temperature in the insulated enclosure runs about 110 degrees F at an outside free air temperature of 85 degrees F (we have about 1 or 2 days a year here at Chautauqua Lake, NY when it gets **that** hot). At 85 degrees F ambient, it only takes 10 mA of Q-3 heater current to hold the Gunn diode cavity at 120 degrees F. You **never** want to cut-off Q-3's current completely, or the circuit will not PTC linearly, and that is what PTC is all about. At the other end of the temperature spectrum, say at a chilly +20 degrees F, it requires about 500 mA current through Q-3 to maintain the Gunn cavity at a constant 120 degrees F in the weatherproof enclosure. We have limited the maximum current through Q-3 to about 500 mA by including the 10 ohm resistance in its emitter lead (two 20 ohm 1/2 watt resistors in parallel) to give us both long life for Q-3 (a 12 watt pnp transistor) and to allow only a cheap 1 amp 12 Vdc regulator to be used in its power supply.

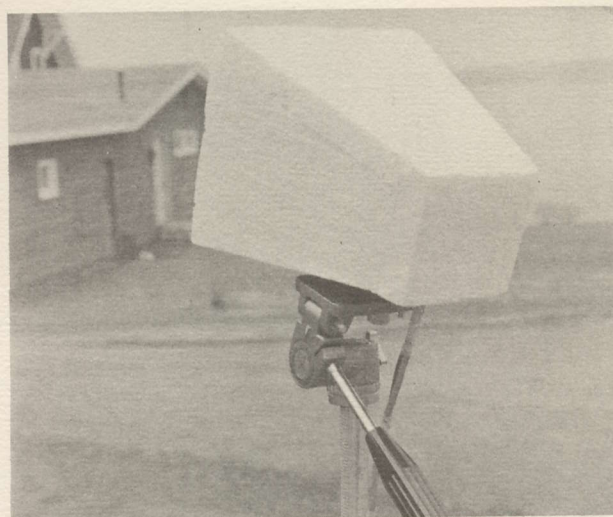


FIGURE EIGHT

When it really gets chilly here at Chautauqua Lake, say from +20 F to -20 F for weeks/months on end, the styrofoam "hat" shown in **figure 8** may be used, or conversely, the 10 ohm resistor in Q-3's emitter may be eliminated if you wish to gamble with the life of these \$.02 power transistors. The styrofoam "hat" may be built from 25 cents worth of 1" thick styrofoam sheet available at most building supply or lumber yards. This particular "hat" was glued together (very carefully) with 5 minute epoxy. "Carefully," because the epoxy ends to dissolve the styrofoam (we'll use resin next try!). At -20 degrees F, the PTC circuit draws approximately 900 mA with the 10 ohm resistor **out** of the circuit. **Note:** from stone cold **off** to fully temperature stabilized **on** averages 15 minutes, so allow this length time before operating. Even with the 10 ohm resistor **out** of the circuit, there is only 6 watts of heat available from the PTC and about 5 watts from the Gunn diode, which is somewhat less than a **high** power heating source at best.

Conclusion

The thermal conductivity of the GPX's small brass Gunn diode cavity is excellent. So much so, try this test to measure the time constant of the PTC system. With your PTC'ed GPX module (**out** of the enclosure) lying open on the workbench (pointed at a far wall to avoid damaging the mixer diode), and a 1 amp ammeter in series with the PTC +12 Vdc regulated

power supply, step back about 5 feet from the workbench and blow lightly at the GPX. Eureka. **It indeed does work.** About 1/2 second after you blew on it, the PTC ammeter will literally jump as from its idling level to about 100-200 mA higher current to compensate for the heat loss from your "whoosh," and then slowly settle back to idle. **Now**, we understand why we shelter this 8 ounce bundle of aluminum and brass from drafts in its weatherproof enclosure for any serious long-term "highly stable" operation. If you choose to PTC the Coleman Terminal's Avantek 4 GHz VTO, we suggest you make a simple 1/4" thick balsawood snug, tight, and draft-free enclosure for it. To waterproof it, simply iron on "monocote" mylar model airplane covering available from most all hobby shops.

"**The Gunnplexer Cookbook**," which will be available late spring 1980 from the Ham Radio Bookstore, Greenville NH 03048, has all the minute details for building this 10 GHz PTC system. What we have covered in this month's column should be adequate for the intrepid 4 GHz satellite enthusiast who wishes to PTC their Avantek VTO and/or GPX 10 GHz microwave TV relay or microwave TV distribution system.

TECHNICAL NEWS NOTES

Announcement at SPTS '80 Miami by **Ramsey Electronics** (P. O. Box 4072, Rochester, NY 14610; 716-271-6487) that it is now offering complete 'Washburn Receiver' (see this month's Technical Section **CSD**) kit for **\$1495** is sure to bring out competitive spirit. Ramsey also offering complete set of **boards** for Washburn Receiver for **\$99.95** and the full receiver wired and tested for **\$2995**. Plus, anyone purchasing STT's 'Washburn TVRO Receiver Construction Manual' receives **10% discount** on any of above with special coupon found in manual. **Boards are ready for immediate delivery**; kits and wired and tested units are on a 6 to 8 week cycle.

WESTAR II (carries SIN, others) burped for over an hour December 11th causing mild panic at Western Union. Apparently this was first full-blown bird outage for II since satellite was launched in 1974.

ARIANE (European Space Agency) bird tests went perfectly Christmas eve and with the further set backs of U.S. Space Shuttle (now rated only 10% likely to fly by June tests, and 50% likely for September) COMSTAR has signed with Ariane to lift COMSTAR IV (replacement for I) in early spring of 1983. Launch on December 24th was carried live in France via Symphonie satellite relay. Indian Apple will launch on Ariane in June with single 4.1 GHz downlink transponder to 'test direct to home telecasting'; will locate 102 degrees east.

Japanese plan launch this month of ECS-B, test satellite operating 32/35 GHz, with single transponder; expected life is one year.

Hughes Aircraft is forming new division to launch a pair of C band (6 up, 4 down) domestic satellites; hopefully as early as first half of 1982. Birds will be 24 channels, provide 34 dBw EIRP over continental U.S. (CONUS), Puerto Rico and Virgin Islands (and one assumes most of Caribbean) from eastern orbit slots of 79 and 75 degrees west. Spacecraft planned will be similar to ANIK-C (which Hughes built) with extra fuel and spare transponders (ala SATCOM FIII). Without major

Next Month

Will cover the construction and operation of a crystal controlled 4 GHz and 10 GHz weak signal source with its own antenna that may be built for less than \$50. It will allow you to put your 4 GHz satellite receiver or 10 GHz GPX transmitters and receivers "right-on" the frequency desired and align their antennas to within a fraction of a degree.

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rejuggling, this leaves one orbit spot at 71 degrees unspoken for plus possible slot at 140 degrees. Projected 79 and 75 degree spots too far east to cover Hawaii or Alaska.

Hardware for proposed marriage of COMSAT and Sears (see **Coops Comment on Programming** this issue **CSD**) is expected to cost \$300 per terminal with \$15 to \$20 range monthly fees. COMSAT also reportedly talking with Tandy Corporation (Radio Shack) and several direct Japanese suppliers about home terminals.

FCC hearings regarding state of COMSTAR turned up that COMSTAR 1 (at least) has power supply problems and FCC apparently 'faulted' ATT for designing birds with footprints that preclude use of all transponders for all of U.S. locations (see **CSD** December 1979 for COMSTAR footprints). COMSTAR attempting to justify construction of additional satellites.

NASA will launch only three communication satellites this year; INTELSAT V-A in February and V-B in May and V-C in August. All are dual band (first INTELSAT use of 12/14 GHz region). Each outfitted with 15 transponders at C band (7 with 36 MHz bandwidth, 8 with 72 MHz bandwidth) and 3 in higher band (2 with 72 MHz bandwidth, 1 with 240 MHz bandwidth).

One approach to shrinking EIRP problems proposed by Hughes commercial antenna offered to cable industry at December Anaheim show; an 'expansion ring' that adds 1 meter size to existing 5 meter antenna (clamps around outside of antenna). Extra one meter at this size adds 1.5 dB gain with price tag of \$3,000 when 'added on' to existing order for basic five meter antenna.

Additional problems with transponder 6 on ANIK-III are making Canadian Telesat people nervous. ANIK-III recently began televising House of Commons debates on transponders 4 (French) and 11 (English) for Canadian cable systems.

CORRECTION - HOWARD TERMINAL UPDATE

Readers working on the Taylor Howard 24 channel tuneable receiver who were pleased to have the updated modifications to the demodulator and video output stages (see page T13 for December 1979) should make the following corrections on their schematics:

- 1) In the 30 Hz clamp/video amplifier stages on the right hand side of the schematic appearing page T13 for December you will find a pair of 1 MFD / 20 volt capacitors between the first 2N2222 and the second 2N2222 stages. The second (right hand) 1/20 should be eliminated and replaced with a direct connection from the first 1/20 (where juncturing with the HP5082/2800 diode) to the base of the second (most right hand) 2N2222. Failure to do this (i.e. leaving both 1/20s in place) will do nasty things to the bias on the 2N2222.
- 2) In the same general area of the schematic there appears (right and below the capacitor in question) a 1N5248 12 volt zener. The zener required here should indeed be 12 volts but a 1N5248 is not a 12 volt zener. Cross out 1N5248.

COOP'S COMMENT ON PROGRAMMING

SATELLITES AND HYPE

Now that the mass media is discovering satellite technology (witness the **NBC Prime Time Sunday** report December 23rd or the **CBS Morning News** report early in January) it has become fashionable for those who somehow conceive that their corporations may have some piece of this action to begin touting satellites in the public forum.

This month's gathering at SPTS '80 in Miami certainly points up that we are at a jumping off place for equipment. At SPTS '79 in Oklahoma in August the hardware on display was from either the cable industry stockpiles or from a handful of far-sighted (but small) firms that had decided to gamble that satellite TV was here to stay. There are a number of significant new pieces of hardware on display in Miami this month but the real significance is not the hardware on display but the people in attendance. SPTS name badges don't identify the individual's business affiliation and that is probably a good thing. But our registration rosters do and when we see dozens of engineers and marketing types from major electronic manufacturing names world-wide on the roster we know that satellite TV is about to take a big step into the corporate big time.

Most of the heavy corporate activity seems to be keyed to the COMSAT announcement that they expect to launch a satellite (they say as early as 1983 but we all know that is more apt to be 1987 or after) to bring six channels of television to anyone that wants to pay for it. COMSAT has got to convince Congress and the FCC that what they propose is worth doing, that they are the people to do it, and that they should be allowed to do it like they want to do it. The fact that they have yet to detail their plan or obtain any permission from any of the necessary authorities to do what they say they will do has not stopped them from hyping the proposed program as if it were an accomplished fact. A prime example of hype was the business announcement early in January that COMSAT would be marketing their 12 GHz antenna-receiver-decoder systems through Sears-Roebuck. That announcement certainly could not be expected to hurt the market value of Sears stock and

publicly owned COMSAT got a lot of free mileage out of it as well.

The fires of public interest are being constantly fueled now by talented writers such as Neil Hickey who penned in the January 5th edition of **TV GUIDE** what he envisions television to be like during the 80's. About satellites Hickey notes "...the potential of the satellite is so great that it will change the entire fabric of society..." and he suggested the afore-mentioned COMSAT system (may become) "a system of transmission that might...one day obviate all others". Humm. If satellites are generally perceived to have such impact, it is no small wonder that Sears-Roebuck and others are cranking out press releases that tell the world they too will be a part of this new form of television.

The danger inherent with all of the Neil Hickey type articles or the Prime Time Sunday television reports is that (1) they look for sensational headline grabbing quotes or comments or revelations, and, (2) they overlook most (if not all) of the engineering, political and economic realities of the already in place satellite system. There is no question that 12 GHz satellite service will one day come to the United States (Canada already has it through the experimental channels now operating on ANIK B) Sears' announcement makes it seem like it is here now, today. That by next Christmas or the Christmas thereafter stores from coast to coast will be flooded with home satellite terminals. We didn't check Sears stock quotations the day of (and after) the COMSAT announcement but we would be surprised if it didn't go up.

There will be plenty more of this 'hype' in the months and years to come. As an insider in the satellite business you will be called upon to give your own views to either interested people or the local press. We caution you to stick to the realities of today as you feed these journalists and broadcasters who are by nature looking for something truly sensational to share with their readers or viewers. The satellite revolution in its real format is exciting enough without unnecessarily hyping it into a Buck Rogers 25th century scheme. No good is served by getting the hopes and expectations of the general public up prior to the time we as an industry can deliver. And we sure aren't there yet!

WE'LL MISS OLIVER

Oliver Swan died on Christmas eve. His death came after a short but painful illness that became apparent last October. As a separate report here notes his family will carry on production of the Swan Spherical Antenna and plans are still on stream for large scale production of the antennas by Gardiner Communications Corporation.

No-one can or ever will replace the creativity of Oliver. A special videotape commemorating some of his accomplishments is being shown during SPTS '80. Oliver was truly a legend in his time and the legend will go on forever.

WARC 79

CSD's report on WARC 79 is being held back until the Department of State has completed its own thorough analysis of the event. We anticipate having it in print in either the April or May issue of CSD.

CSD

PROGRAMMING



COOP'S SATELLITE DIGEST (Programming Edition) is produced monthly by Satellite Television Technology, P.O. Box G, Arcadia, Oklahoma 73007 (405-396-2574). CSD is available in two separate editions (Programming and Technology) or as a combined subscription. Subscription rates are \$30 per year for first class mail delivery within U.S.A. or Canada for either edition, or \$50 per year for the combined editions. Outside U.S.A. or Canada add \$25.00 per year for any subscription. All subscriptions to be paid in advance in U.S. funds drawn on a U.S. bank; no invoicing. Contents are Copyright 1980 © by Satellite Television Technology and any duplication or reproduction in any form without written permission is a violation of Federal Statute (17 USC 101 et seq.).

THE FIII DISASTER

RCA FIII GONE???

As reported briefly in last month's **CSD**, RCA lost SATCOM FIII and apparently the mystery of what actually happened to the new 'cable television satellite' will not be answered soon; if indeed ever.

RCA's FIII managed a proper lift off from the Cape on schedule on December 6th after a successful launch atop a Delta 3914 launcher. However early on the morning of December 10th, when the satellite was in the process of being transferred from its inclined or elliptical transfer orbit to a 'drift orbit' that would have approximated the final geostationary circular orbit all telemetering signals from the bird were lost. The transfer from an elliptical transfer orbit to the drift orbit is handled by firing of a small rocket called an 'apogee kick motor'. Approximately 15 seconds after the firing of the apogee kick motor all communications disappeared.

In the for-what-its-worth department a similar event occurred in July of 1970 when an Intelsat bird (3F8) also aboard a Delta launch vehicle at lift off also disappeared forever 15 seconds after the apogee kick motor was fired. **The 3F8 bird was never heard from again.** Earlier, another Intelsat bird (2F1) blew a cowling when an apogee kick motor also failed although this bird was partially recovered after the incident.

Theories are a dime a dozen as to what happened to the satellite. They run the gamut from an explosion of the satellite itself set off by the firing of the apogee kick motor to an improper 'burn' of the kick motor sending the bird into some unknown orbit that apparently cannot be traced. Alternate theories have the satellite in a drift orbit (assuming in this case the apogee kick motor did what it was supposed to do) but electrically inoperative due to a massive failure of the powering system on board.

Immediately following the incident, which occurred while the RCA Astro-Space Division was still 'flying' the satellite and prior to it being turned over to RCA Americom for operation,

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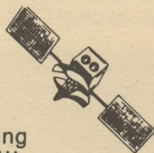
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RCA contacted NASA, NORAD and other agencies both public and private to seek assistance in tracking of the satellite. Apparently all such efforts failed to produce any indication that FIII (or parts thereto) was anywhere to be found. NORAD was conducting the most diligent search utilizing a computer enhanced sector by sector radar profile which systematically searched the most likely areas in space where the satellite might have gone to or where pieces might be expected to be found if indeed it did blow up.

RCA carried massive insurance on the launch (approximately \$70 million worth) with a premium of near \$7,000,000 with a number of insurance carriers. Cable industry leader Ed Taylor of Southern Satellite Systems noted **"the insurance premium pretty much tells the story; this was nearly the tenth domestic bird to be launched (WESTAR has three, COMSTAR three and this was to have been RCA's third) and the premium was just about 1/10th of the insured amount. The insurance carriers apparently figured the risk was in the 1 in 10 ballpark..."**

As reported on the January 3rd and 10th edition of **Satellite Magazine** (see transponder 21 at 12 noon eastern each Thursday) the primary concern with the cable industry seemed to be whether some of the new (for cable television) services scheduled to begin operation after the successful launch and positioning of FIII could indeed be accommodated on the birds presently in orbit. FIII, to be have positioned at 132 degrees west, was to have been a brand-new totally-for-cable-TV satellite with 24 transponders dedicated to that purpose. Virtually all of the present cable TV services operating through F1 were to have moved to FIII and they would have been joined by approximately four additional (not presently operating) services to fill out the 24 transponders. At that point RCA was going to make 11 of the presently operational 22 transponders on F1 (4 is broken totally and 14 is not fit for full time, full power service) available for what RCA was at the time of launch calling "The Second Cable TV Network". RCA reportedly had several of these 11 transponders pre-leased to would-be-programmers to the cable TV industry.

With the loss of FIII where does the cable industry find itself today? At least two new fulltime programmers **will be able to be accommodated** on F1. Transponders 15 and 19 have never been assigned (by RCA) to television programming. One has been in east-west while the other has been in west to east SCPC service. This audio-only pair of transponders has been in keeping with an informal RCA policy that until now each of their satellites will have the capacity to do both television and SCPC work when called upon. RCA will vacate 15 and 19 by moving this SCPC service elsewhere (SATCOM FII is a likely spot). That's two of the four additional spots which cable was to have gotten on FIII. Transponder 14 on F1 was originally assigned to Trinity's KTBN but a problem developed with it and Trinity was switched to 13. Transponder 14 is not gone, but it has stability problems which make it unsuitable for full-time video service (at one time the story was that with prolonged use the transponder may drop from the nominal 5 watt power output to something closer to (or below) 1 watt; a more than 6 dB drop in EIRP which CATV type receiving antennas could not tolerate.)

Just after the launch itself (but prior to the loss of FIII) these were the four additional users who were expected to appear on the four newly available transponders on FIII:

- 1) **National Christian Network** (a 24 hour per day new religious transponder)
- 2) **Cable News Network** (Ted Turner's new service slated for a summer 1980 start)
- 3) **HBO** (their fifth transponder)
- 4) **Showtime** (their fourth; they presently have 10, 12 and 17 but sublet 17 to Eastern Microwave for transmission of New York City's WOR).

HBO already utilizes 22 and 24 for their west and east coast feeds. They also utilize 23 for their 'mini-pay' service TAKE-2. Their transponder 20 is a reserve or backup and many firms use it on a per program feed basis on a sublet basis. HBO is said to be working on at least two new services which they apparently intended to 'launch' with the cutover to FIII. One of these was to have been a **24 hour-per-day** premium service channel. HBO, affiliated in a corporate way with Time-Life, is

also scheduled to begin feeding 6 hours per day of English (BBC and ITV) programming to cable system clients around April 1st and even with the loss of FII we understand that this 'English TV' feed will most likely still go ahead on reserved transponder 20.

Showtime has said less (if anything) about their plans for a fourth transponder. It has been assumed by cable industry insiders that Showtime **did not have** an immediate plan for it however; they were probably planning to sublet it as they now do 17 until their own plans for regular use jell.

If HBO can get along with their present four and Showtime is not that anxious to use a fourth of their own, that leaves us then with Ted Turner's Cable News Network and the new National Christian Network to place on the to-be-available transponders 15 and 19. Seemingly there is a fit (two for two).

There are other elements involved however. Eastern Microwave (WOR) is not happy with their present sublet status on 17 fearful that they could be forced to vacate 17 on short notice if Showtime decided they needed 17. Others who have something called **preemptible service** (the lowest class of transponder service available) and who had planned to 'upgrade' their status with the move to FII are for the time being stuck in a posture of being the first to go (at RCA's discretion) if a transponder fails for some RCA customer with a higher grade of service (transponders 3,7,9 and 21 are considered the most risk prone for preemption on F1). Naturally the firms presently occupying these four transponders are nervous since they could be bumped at anytime (as all four were last September when FII had a bad day in the sky and RCA had to temporarily shift all Alaskan traffic back to F1).

RCA has the cable industry where it wants it; on an RCA bird(s). The cable industry had talked itself into having to have two satellites (FIII as the primary and FI as the 'second network') so the cable industry seemingly is now ready to spend money for a second satellite antenna. RCA would like to create a way for cable's 'second network' to be on SATCOM FII if it can. Unfortunately FII is a less than ideal bird for this purpose.

Cable started on FII and moved to FI back in June of 1978. FII had excellent service and coverage and many of the original cable systems utilizing satellite still maintain that FII service was superior in most respects to FI (particularly in the east and southeast since FII sits at 119 degrees west which produces a far better 'look angle' for areas like Florida and New England). In spite of these good vibes from old timers in cable-satellite, FII has problems:

1) One transponder set (3, 7, 11, 15, 19, 23) is a special 'Alaskan beam' which has EIRPs in the 29 dBw region no further east than the Chicago-New Orleans line with levels in the 26 dBw region along the east coast. This transponder set could not be used for a nationwide service.

2) At least two other transponders (not in the above set) are ill or not functioning at all.

For cable's nationwide purposes, this converts the 24 channel new-bird capacity to at best 16 transponders.

3) RCA has one complete set (of two) east-west and west-east SCPC/FDM transponders on FII and if the 15/19 set on FI is moved to FII that totals four more transponders not available for cable's use.

And 16 transponders has now become 12 potential transponders.

4) NBC has also a contract with parent RCA for use of transponder 8 (or some other as selected) for backfeeding TV program material from Hollywood to New York on a regular (as in almost routine) basis.

12 now becomes 11.

5) RCA has an undetermined number of additional business customers utilizing a variety of formats (including video) which they must be prepared to service when called upon (Robert Wold for example).

Only RCA knows who these firms are or what their requirements are but we must assume that 11 is not 11 at all but some lesser number.

6) RCA, to remain competitive with WESTAR and COMSTAR for 'occasional use' customers who require trans-

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ponder space in a hurry to televise news, sporting and other events must have some spare capacity. The long haul in the satellite business will require that **any** satellite owner be prepared to give space as able when required and RCA does not want to lose this ability and therefore pass the ball to WESTAR and COMSTAR without a contest.

So the 'strain' on RCA SATCOM FII is considerable. One possibility kicked about calls for RCA to go to WESTAR or COMSTAR to lease from them transponder space for some of the RCA customers (such as the NBC transponder, or the SCPC/FDM transponders). To do this RCA would, among other things, have to retrofit their own TTC uplink and straight uplink stations with an additional antenna so that RCA 'ground' customers could be linked from RCA ground to RCA ground via a leased WESTAR or COMSTAR transponder. One also must consider carefully the footprints of COMSTAR (see CSD for December), which are at best strange since each set of four antennas (six transponders per antenna) has a distinct pattern all of its own and none of the COMSTAR antenna sets provides anything approaching Hawaii to Maine plus Alaska to Puerto Rico coverage. WESTAR has a broader antenna beam but fewer transponders available (12 versus 24).

RCA has a backup agreement with the Canadian Telesat (ANIK) family wherein in the event of a massive failure of a SATCOM bird RCA can lease on an emergency basis 11 of the 12 transponders on an ANIK bird. Unfortunately ANIK I and II are at best ill and they can largely be discounted from serious use by anyone. ANIK III reportedly has an erratic transponder 6 and possibly another on the fritz. And since Canada's Telesat signed that agreement with RCA ANIK III has become an important bird for the Canadian cable industry and others (transponders 4 and 11 are currently feeding Canada's House of Parliament to Canadian cable systems so equipped). The new ANIK B, one year in service this month, is a dual-band bird with capacity for both 4 GHz downlinks and 11/12 GHz downlinks (12 transponders on 4, and 4 transponders on 12). However the operational power capabilities of ANIK-B are such that only 12 of the 16 transponders can be 'fired' at once (in whatever combination Telesat wishes). At the present time two of the ANIK-B 12 GHz transponders are in daily use for the CBC English language feed and the new feed of Vancouver CHAN-TV as an 'independent' CTV network feed. Canada has hundreds of millions of dollars riding on the successful demonstration of the new ANIK-B 12 GHz service since they see this demonstration as being key to developing Canada as a technology source for 12 GHz satellites and 12 GHz receiving systems for worldwide marketing. You don't mess lightly with the 'Crown Jewels'!

Thus we have a ripple or domino effect at play here. The seeming 'great capacity in the sky' is not so great after all. WESTAR is a victim of its present success in selling services to regular customers plus its 12 channel capacity. COMSTAR is a victim of its strange (by design) footprints (plus there are persistent rumors that COMSTAR 1 at 128 degrees has power

supply problems). ANIK has four birds up but the oldest two are largely occupying space in space and the remaining two have other special constraints; and no ANIK has suitable U.S.A. coverage. RCA has a full F1 (with two transponders missing) and a confused FII loading posture.

On top of all of this FII is maintained on a day to day basis through the sheer guts and determination of a handful of dedicated RCA flight controllers and engineers. FII has a mal-functioning solar panel rotational system; once each day the automatic tracking of the solar array is shut off and the array is manually (i.e. by control from ground) spun backwards some 330 degrees so that a 'cable' that apparently broke loose during the initial launch doesn't snare the giant solar panel and hang it up. FII has had some attitude problems; last September the bird 'went berserk' and for one long day RCA seriously wondered whether they could bring it back under control.

So if RCA does move transponders about and create room on SATCOM FII for a 'second cable network' on an interim basis, there will remain the distinct possibility that FII may give superb service only until the time the bird decides to act up. And that (based upon actions of the past) could happen at anytime.

What about FIV? Normally there is an on-ground spare. RCA FIII was the spare for SATCOM. RCA has to obtain FCC permission before it can start construction of an on-ground spare (the tariff which RCA charges is based upon its investment in satellite hardware and services and the construction of an on-ground spare therefore becomes part of the tariff base) and it did so only last fall. The best estimates, by RCA, of when SATCOM IV will be ready to fly is in the spring of 1981. The earliest launch date is therefore in the April-July span of 1981. And in the interim, if F1 or FII burp and fail? There will be no replacement available. (In a catastrophic failure situation, where there is an on-ground spare ready to go, the best estimates are that it would take no less than 90 and perhaps 180 days to get a replacement into position.)

Viewed as a 'whole-situation' rather than a bird by bird set of isolated parts, the tenuous nature of the present North American DOMSAT satellites is more evident. No **single** disaster is likely to wipe out **all** of the capacity in the sky, but if any part of what is now in place should fail, there are bound to be ripples of repercussions felt all up and down the line. Even in space, nobody stands alone.

WTBS PROGRAM

SCHEDULE/OPERATION

WTBS GROWTH

Just over three years ago Atlanta's WTCG became the first United States broadcast television station to begin regular distribution via satellite. Within hours of an FCC ruling that WTCG (now WTBS) could be relayed from the Atlanta market area to distant cable systems via microwave Southern Satellite Systems (the common carrier authorized to carry WTBS via satellite) had the signal on the bird on transponder 6 and within a couple of weeks several thousand U.S. homes, far from the Atlanta market, were able to tune in Ted Turner's "Super Station" (although that nick name would come many months later). Late this past November WTBS passed the 5.5 million home mark via cable served homes and there continues to be no let up in the progress the station is making. (By comparison New York City's WOR, **before** it also became a satellite relayed service, was averaging **weekly viewing** in the under four million home statistic area.) The WTBS audience reach is huge, from Hawaii on the west to the Virgin Islands on the east, Alaska and (illegal terminal served) Faro, Yukon on the north to deep into the Caribbean and Mexico on the south.

The WTBS schedule (see current week's guide here) is innovative and far more intriguing than most indie stations in the United States. Ted Turner went into the satellite relay business with a film library of more than 3,000 films and a good hold on most of the popular (if older) syndicated shows. Turner had negotiated his film library and syndication purchases far in advance and many now feel he did so prior to going on the satellite so as to be able to 'coast' for several years without worrying about the impact his satellite distribution might ultimately have on the rates his station pays for programming.

WTBS, unlike all of the other indies available via satellite, has worked hard to help the cable systems promote the service.

Turner's people help cable affiliates with advertising materials, even co-op advertising dollars, to see that when a town "turn's on WTBS" that everyone in the area is aware of the new service. WTBS maintains a highly skilled promotional department that sees to it that newspapers, magazines and other outlets where people turn for TV program information have ready access to not only the weekly schedules but a wide range of support materials listing the station's heavy sports and specials schedules.

WTBS is so well known that the station now regularly receives mail from people who learn about satellite TV. Typical letters ask WTBS for information on where the writer can learn more about the equipment required to receive WTBS **directly via satellite!** (Station personnel routinely answer such letters with a form letter that sends the enthusiasts to CSD we might add.)

Ted Turner has hitched his resources to the cable/satellite 'star' and his innovation and daring have only begun. Scheduled for a mid-1980 start, likely based on Satcom I Turner's Cable News Network (CNN) which when operational will bring into the cable (and direct view satellite homes) a full twenty four hour per day news channel service with live anchor people, extensive live and tape delayed reports fed to CNN via satellite from news making sources around the globe, and an extensive schedule of in-depth interviews and looks behind the headlines of the day. Turner has funded CNN (for which a new building is now being renovated in Atlanta) by digging deep into his own pocket and selling off such assets as a North Carolina UHF station which he previously owned. Turner feels that launching CNN may take upwards of \$40,000,000 and there will be a \$2,000,000 per month overhead to meet while the service operates at a loss and becomes established. Cable systems taking the CNN service will be paying a flat fee (around \$.15 per home per month) in the early days and as advertising support for the unique 'live-24 hour-news-service' picks up the cable rate per home per month will gradually go down so that eventually the service will not cost the cable operator anything to have on his system. Turner is hoping to have more than two million U.S. cable homes ready to plug into when the service kicks off next June, and is shooting for 7 million plus homes as quickly as possible to 'cover the operating nut'.

Most of the key CNN staff people are already on the job working out the logistical details of the new service. Turner intends that his CNN service will take every advantage of the technology that the satellite age has to offer and in this respect his 24 hour per day service will be extremely unique. Not 'boxed in' to 30 minute or even 60 minute time limits, such as the network newscasts are, Turner intends that by marrying live satellite relayed news reports to an open-ended format his CNN service will stand out for its immediacy and attention to detail. For any died in the wool news buff, this June can't come fast enough!

COOP'S

SATELLITE DIGEST

P5-2/80

WTBS
17 ATLANTA

*Formerly WTCG

PROGRAM SCHEDULE

THE 24-HOUR TV STATION WITH 40 MOVIE SHOWINGS A WEEK

1018 West Peachtree Street, N.W., Atlanta, Georgia 30357 (404) 875-7317

CENTRAL STANDARD TIME

Schedule Eff. 9/24/79

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	TIME
5:00	Listen	World At Large				Human Dimension	Between the Lines	5:10
5:30	The Athletics	News				It's Your Business		5:30
6:00								6:00
6:30	Three Stooges & Little Rascals				(6:00 M-F) N* (6:30 M-F) N* (7:00 M-F) N*	3 Stooges Little Rascals	Jimmy Swaggart	6:30
7:00	Leave It To Beaver				(7:30 M-F) N*	Ultra Man	Dr. E.J. Daniels	7:00
7:30	Romper Room					The Partridge Family	3 Stooges & Friends	N* 7:30
8:00	The Lucy Show						Lost in Space	N* 8:00
8:30	Green Acres					Maverick		N* 8:30
9:00							Hazel	N* 9:00
9:30								N* 9:30
10:00	Movie 17					Hollywood Classics		N* 10:00
10:30							Academy Award Theatre	N* 10:30
11:00	News 11:55							N* 11:00
11:30	Love American Style							N* 11:30
12:00						Movie 17		N* 12:00
12:30	Movie 17						Movie 17.	N* 12:30
1:00								N* 1:00
1:30	News 2:25							N* 1:30
2:00	The Gigglesnort Hotel							N* 2:00
2:30	I Love Lucy				(2:00 M-F) N*	Movie 17	Movie 17	N* 2:30
3:00	Flintstones				(2:30 M-F) N*			N* 3:00
3:30	Spectreman				(3:00 M-F) N*			N* 3:30
4:00	Gilligan's Island				(3:30 M-F) N*	Movie 17	Movie 17	N* 4:00
4:30	My Three Sons				(4:00 M-F) N*			N* 4:30
5:00	I Dream of Jeannie				(4:30 M-F) N*			N* 5:00
5:30	Carol Burnett				(5:00 M-F) N*		Best of Championship Sports	5:30
6:00	Bob Newhart				(5:30 M-F) N*	Championship Sports	Nashville on the Road	6:00
6:30	Sanford & Son				(6:00 M-F) N*		Porter Wagoner	6:30
7:00	All In the Family				(6:30 M-F) N*			7:00
7:30	Falcon Football				(7:00 M-F) N*	Pop! Goes the Country		N* 7:30
8:00		Movie 17			(7:30 M-F) N*	Good Ol' Nashville Music	Movie 17	N* 8:00
8:30	Movie 17				(8:00 M-F) N*			N* 8:30
9:00	(9:00 M-F) N*				(8:30 M-F) N*			N* 9:00
9:30	(9:30 M-F) N*	Six Wives of Henry VIII	Upstairs/ Downstairs	Civilisation	Valiant Years	Movie 17	Comeback	N* 9:30
10:00	(10:00 M-F) N*				Up Close		Ruff House	10:00
10:30	Last/Wild	Elizabeth R	Last of the Wild					10:30
11:00							Open Up	11:00
11:30	Movie 17					Rock Concert		11:30
12:00						Juke Box	Movie 17	12:00
12:30	17 News Early In the Morning							12:30
1:00						Movie 17		1:00
1:30	Movie 17							1:30
2:00								2:00
2:30								2:30
3:00						Movie 17	Movie 17	3:00
3:30								3:30
4:00	Movie 17							4:00
4:30								4:30
4:40						Agriculture USA		4:40

N*: 30 News Update

What does the future hold for the one true 'Super Station' on satellite; WTBS? Turner's personnel are beginning to see indications that while WTBS cable-reach growth continues healthy, saturation may be on the horizon. The FCC has rules on the books which limit the number of non-network (independent) stations a cable system can carry (in many areas) and for many cable systems in the northeast and around Chicago, that 'quota' was reached **before** WTBS became available, or so popular. There is a general feeling at WTBS that perhaps when Warner Cable does drop KTVU from satellite carriage sometime early this year that the three remaining indies on satellite may remain the only indie signals available for quite sometime; at least until the FCC re-addresses the indie-quota-system or until the natural development of WTBS programming makes it look less and less like an indie and more and more like a network unto itself. There is a popular theory around that making WTBS look so much different than other indies that it can stand alone is exactly where Turner is headed with the station. While Turner continues to lean on movies and sports for much of his programming appeal, there are indications that he is seeking

to fill the balance of the programming day with material which simply is not found on other indie stations. If he can do this, successfully, he will then be able to proclaim that WTBS offers viewers a real alternate viewing choice not available on any other station in the United States and via the backdoor he just may become a network of his own in his own right.

WTBS 1980 SEC AND ACC TELECASTS

An extensive schedule of Southeastern Conference and Atlantic Coastal Conference college basketball games is scheduled through the winter on transponder 6's WTBS.

Date	Day	Eastern Time	Team
2-06	Wed.	9:00PM	Vanderbilt / Auburn
2-09	Sat.	TBA	SEC wildcard game
2-11	Mon.	9:00PM	Alabama / Georgia
2-11	Mon.	11:00PM	Wake Forest / NC State (del.)
2-16	Sat.	7:00PM	Virginia / NC
2-20	Wed.	9:00PM	NC / NC State (delayed)
2-21	Thur.	9:00PM	Georgia / Tenn.

RUSSIA'S U.S.

VIEWABLE BIRDS

by
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Grenoside
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England

Soviet Geostationary Satellites: An update

Since my last contribution appeared in CSD, I have gathered more detailed information on the current state of these satellites. **Table One** is from a reliable source, and indicates the situation as it stood in November/December 1979. There are a couple of points of interest here - of special interest to North American readers. First, I was mistaken about the identity of Statsionar 4. It is now revealed as one of the new high-capacity **Ghorizont** (Horizon) satellites, its multiple TV channel capability and spot beams making it a considerable advance on the earlier Raduga birds, which seem to be similar to Molniya 3 type, though no detailed information is available.

The 14° West position of this bird makes it visible to the eastern United States, in fact, as Coop pointed out in the November '79 CSD, if you are east of the north-south line joining Chicago and New Orleans it will be above your horizon. And with **up to five channels of TV** it's worth looking for. Programs are for the most part in Russian, and include movies, opera, concert, childrens, and much emphasis on news and sport. I haven't seen any baseball yet, but soccer and ice hockey are common, plus athletics when in season. The Moscow Olympic Games will occupy much transponder time this coming summer. Frequencies and transmission standards? See below.

The second interesting fact evident from table one is the location of **Raduga 4**. Only launched in 1978, we would expect it to be fully operational. Yet it is reported as being maintained at 87°W, not only a non-Statsionar location but in fact a slot allocated to, and occupied by, **Comstar 3!** Why? I'm open to suggestions. If the published data is correct, the satellite is **not in view from any part of the Soviet Union**. The maintenance of that longitude within a fraction of a degree over several months, and not being one of the gravitational equilibrium points, **demands control**. Perhaps the spacecraft is under command from a **Soviet ship**, or from some territory in view of 87°W (i.e. Cuba??). If it were to transmit on its TV channel of 3895 MHz, it would interfere with Comstar 3's channel 10, and would surely suffer interference on its 6 GHz uplink. Perhaps we should keep a check on that channel!

How to Find Molniya Satellites

In December CSD I described the orbit used by the Russians for their Molniya satellites in the Orbita system. Recent Molniya launches have averaged an **inclination of 62.82 degrees**, apogee of **39825 km** and perigee **580 km**. As the orbit ages, perigee falls steadily to **100 km** before decay occurs, after

NAME OF BIRD	LAUNCH DESIGNATION	STATUS OPERATIONAL?	LOCATION
Cosmos 637	1974- 17A	dead	drifting
Molniya 38(S1)	1974- 60A	dead	drifting
Cosmos 775	1975- 97A	dead	drifting
Raduga 1	1975-123A	dead	80°E?
Raduga 2	1976- 92A	Statsionar 3 spare?	85.41°E
Ekran 1	1976-107A	ex Statsionar-T, dead?	53.46°E
Raduga 3	1977- 71A	Statsionar 2, operational	35.32°E
Ekran 2	1977- 92A	ex Statsionar-T, dead	drifting
Raduga 4	1978- 73A	spare	86.97°W
Ghorizont 1	1978-118A	Statsionar 5, operational	55.36°E (inclination 11°)
Ekran 3	1979- 15A	Statsionar-T, operational	98.19°E
Raduga 5	1979- 35A	Statsionar 3, operational	84.22°E
Ghorizont 2	1979- 62A	Statsionar 4, operational	14.30°W
Ekran 4	1979- 87A	Statsionar-T replacement?	not yet available

a typical orbital lifetime of 5 or 6 years. At the chosen inclination, precession forces are nearly balanced, and the perigee remains constant near 270 degrees. This means that **apogee remains as the most northerly point of the orbit**, from where a large portion of the **northern hemisphere** can be covered. The satellite's motion being at its slowest near apogee, **and in the same direction as the earth's rotation**, means that for a period of **six hours or more** this coverage is available, and with only a few degrees of movement required on the earth station antennas.

So what is the nature of this 'northern hemisphere' coverage? **Which part** of the sky do we need to explore **to find a Molniya**? If we consider all possible Molniya orbits, we find that their apogees all lie on a **circle** a little over 20,000 km radius, **with its center 34,500 km above the north pole**. This circle is in a **fixed** position relative to the earth's surface, and its shape can be drawn upon a view of the sky from any particular point on earth, in just the same way as we can draw the arc of the geostationary orbit.

In diagram one I have plotted on polar graph paper a view of the sky from one particular spot in the United States. This point, at the intersection of latitude 40°N and longitude 95°W has been chosen not because of any concentration of satellite terminals in the vicinity of St. Joseph, Missouri, but as a representative central USA location with 'round number' geographical coordinates. The view is similar to that which would be seen by a camera with a 180° 'fish-eye' lens looking **directly upward** from ground level. **The zenith is in the center**

and **the horizon around the edge**. To relate it to everyday experience it is perhaps best to look at the lower half of the diagram at any one time, from horizon up to zenith. To take a different view, the diagram should be rotated to bring the required bit of horizon to the 'bottom' of the picture. (I'm working on Coop to print future **CSDs** on round paper!)

Now starting with southern horizon **nearest** to us, looking south (from St. Joseph) and elevating 44 degrees we come to the geostationary orbit - in fact the highest point of that orbit as seen from our chosen location, the location of Comstar 2 at 95°W. Each side of this point, the orbital arc dips away towards the eastern and western horizons - the orbit meets the eastern horizon at a geostationary longitude of 15°W, and meets the western horizon at the point 175°W on the orbit, so defining the section of the (geostationary) satellite 'parking lot' visible from our (St. Joseph) station. We would certainly not expect to find any satellite TV in the **northern** part of the sky; if we didn't know about Molniya.

Turning the page around, so as to place northern horizon at the bottom (diagram 1) the curve can be seen which represents **our view** of that imaginary circle above the pole: the locus of all possible Molniya orbit apogees. It may come as a surprise, but **the full 360 degrees of this circle are visible from our hypothetical Missouri location!** Like the geostationary curve, I have labelled it in degrees of longitude. The nearest point of the circle is that nearest the zenith, at 95°W. The most distant is at 80°E, on the other side of the pole, and over the Soviet Union. The spot marked '**pole**' is that point on the



HIGH QUALITY Gorizont 2 [Statsionar 4] reception by Birkill this fall on 3695 MHz on 8 foot parabolic with 180 degree K system. This satellite, located at 14.3 degrees west, is visible in eastern half of U.S.A.

celestial sphere **directly above our north pole**, being the position of the pole star, Polaris or Alpha Ursa Minoris. **This star is always due north of us, at an elevation equal to our geographic latitude.**

But what does the circle represent in terms of finding the satellite? The key is in the fact that Molniya satellites are orbited **in groups**, following the same orbital track within a degree or two, **but spaced out along the orbit**. The spacings are such that each satellite need only operate for a period of **6 hours or less**, around its **apogee point**, before service is switched to the **next** one approaching its apogee. So **our apogees circle** is close to being **our zone of interest**. In practice, we should consider this zone to extend some 20 degrees outwards (away from the pole star), and to provide for tracking the Molniyas as they approach the circle, touch it at one point, and recede from it, tracing out small arcs in the sky as shown at A, B, and C in

diagram 1, dependent on the longitude of apogee but never venturing inside the circle.

Due to the variations in gravitational field around the earth, the plane of the orbit 'regresses' westward about the earth's axis. For the Molniya orbit the rate of regression is small, being about **0.15 degrees per day**. So in time the longitude of the apogee point will travel right around the earth, getting back to where it started. As explained in December's diagram 2, **each orbital plane produces two apogee points** on its earth track, **spaced apart by 180 degrees** in longitude and **12 hours in time**. So a satellite that apogees at 100°W will apogee again at 80°E, 12 hours later. Having placed a group of satellites into such an orbital plane, it is up to the operators of the system to decide how to use these two earth-related apogee points.

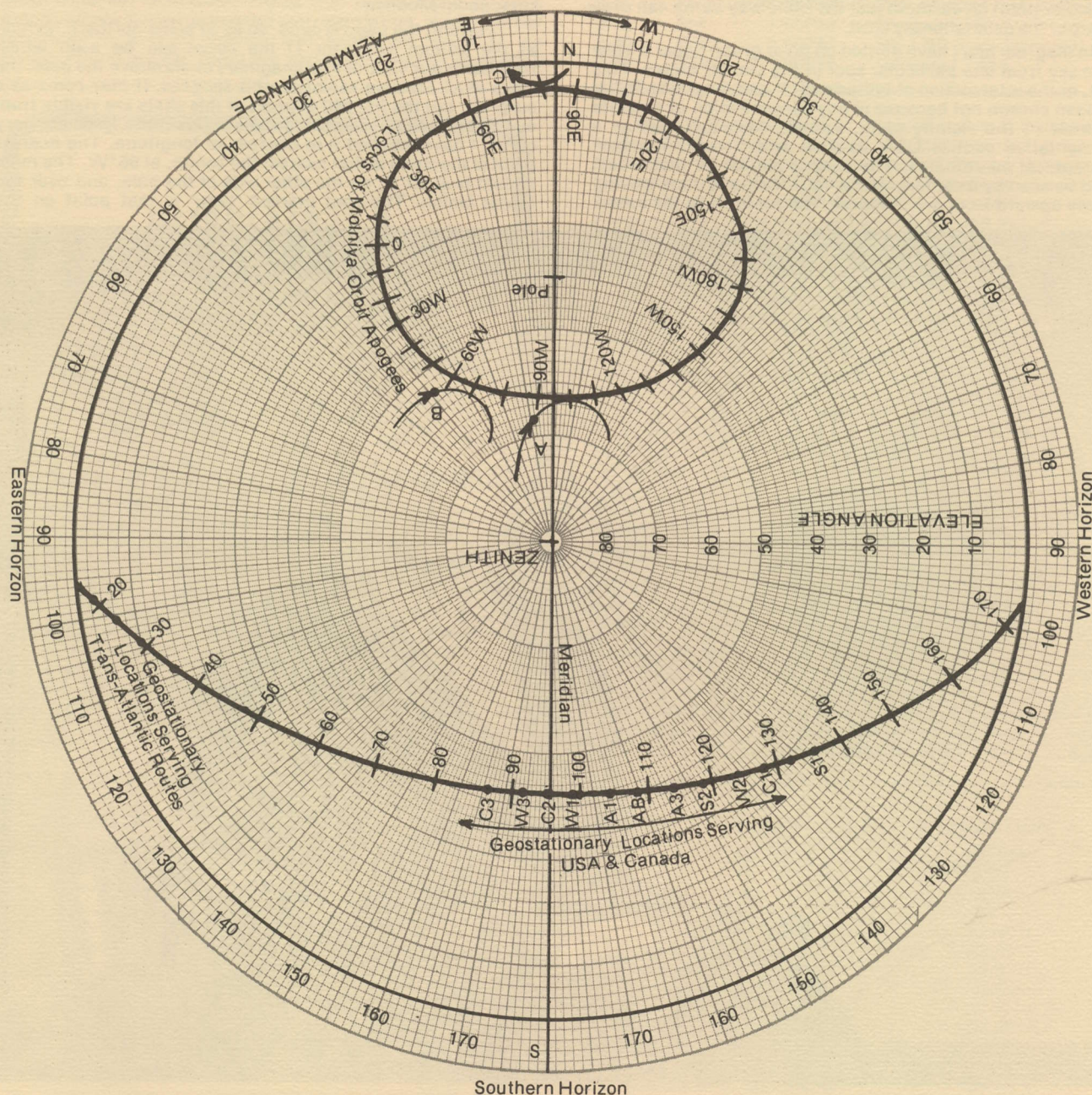


DIAGRAM ONE - View of sky from example location at 40°N, 95°W showing geostationary orbit and Molniya Apogee Circle.

Now it happens that at the time of writing the principal Molniya 3 (Orbita TV) orbital plane has apogees at about 100°W (over the USA) and 80°E (over the USSR). Remember that these are regressing westward by some 0.15°/day, but that amounts to only 54 degrees per year, or probably slightly less, so things will not change a lot **during 1980**. Now a surprising fact: my observations reveal that the Russians are using **not** the 80°E apogee, **but the 100°W apogee[!]** for television relay. **So the whole of the USA is covered by** (single channel) **Orbita TV from Molniya 3 satellites.**

So where do I look if I'm not in Missouri? Well, diagram one has longitudes marked on the apogee circle for a location of 95°W. The 95°W is uppermost on the curve. If your location is say Philadelphia PA (40°N, 75°W) then **your** curve will be the same, but its uppermost point will represent 75°W, and your 100°W point will be where 120°W is marked on the Missouri diagram. Similarly, at Denver CO, (40°N, 105°W) your highest point (on the meridian, closest to the zenith) will represent

105°W, and the 100°W apogee will appear 5° east of you along the curve, at the point marked 90°W on the Missouri diagram.

For latitudes other than 40°N, **diagram two** shows a family of curves. It should be possible to interpolate from these with sufficient accuracy for latitudes between 25° and 55° - enough to cover the continental US and much of Canada. For clarity I have not shown the apogee longitudes on this diagram, but they occupy similar relative positions as those in diagram one they can be projected with sufficient accuracy to get within 10° of the satellite, which anyway will have to be 'found' until its degree of progress along its 6-hour arc ('A' in Diagram One) is found. After a while you will come to know these for your location and relate them to time of day, enabling you to pinpoint a satellite immediately. The Orbita stations have regularly updated charts (available in the USSR) for antenna pointing, but I do not have access to these. For interest, I have also included on diagram two the four views of the geostationary orbit from the four example latitudes shown, to

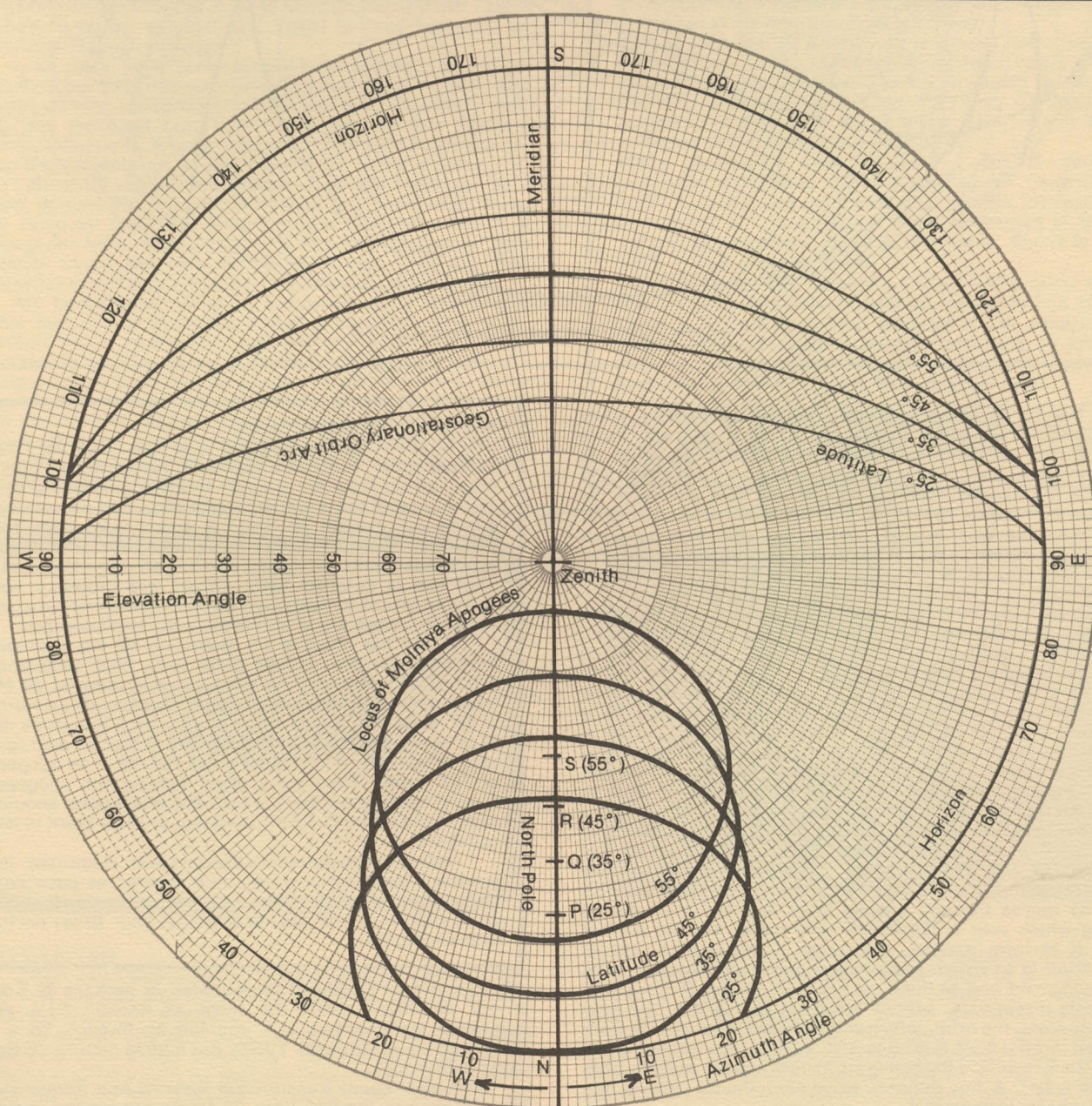
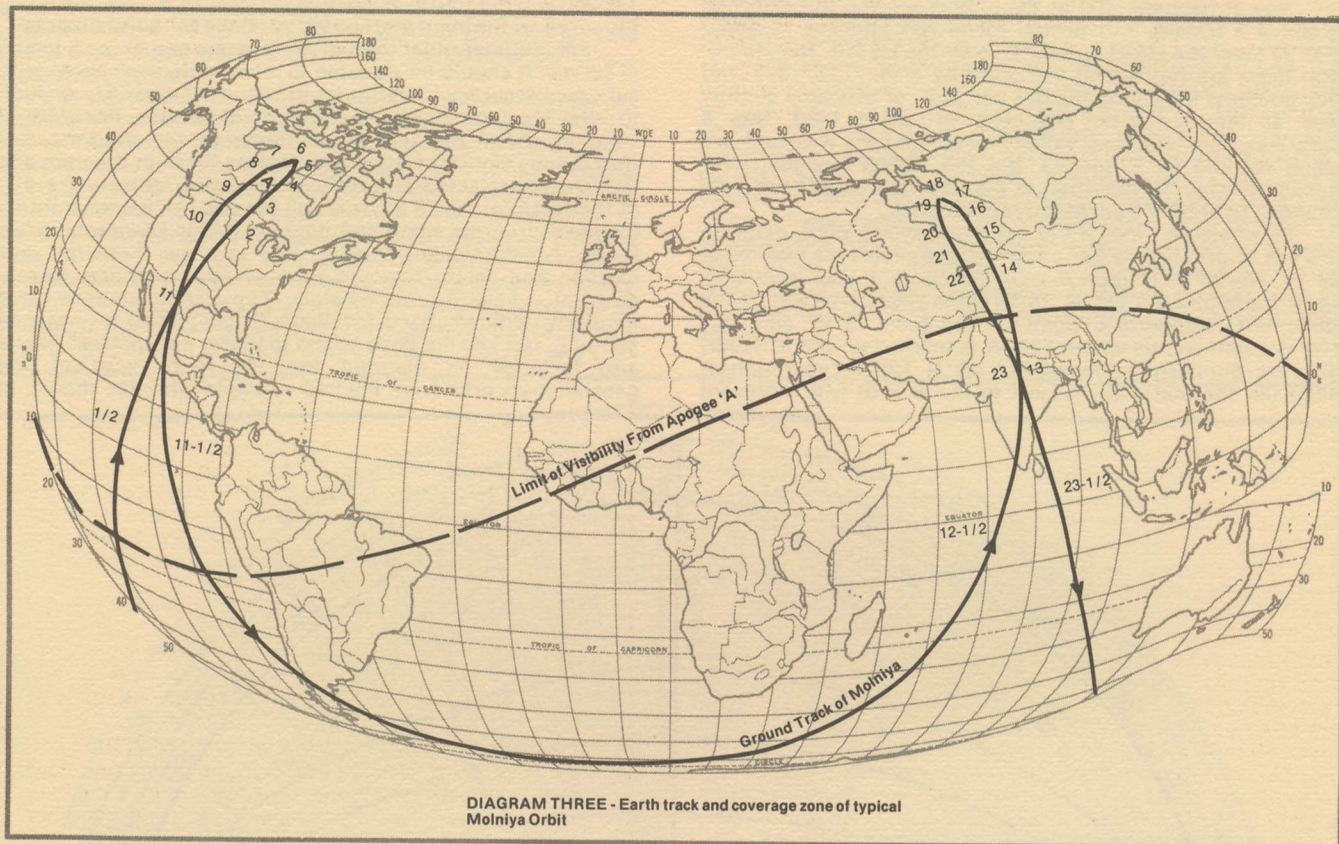


DIAGRAM 2 - View of sky from latitudes 25°, 35°, 45° and 55°



show how its elevation decreases moving northwards, while the Molniya elevation increases. At 81.5 degrees north geostationary elevation falls to zero for a satellite due south. At 35°N the most distant Molniya apogee has zero elevation, and at 19°S the nearest Molniya apogee has zero elevation. At latitude 25°N some 100 degrees of the Molniya apogee locus are below the horizon and inaccessible, but this does **not** include the currently active point, A. Four apparent positions of the pole star, P, Q, R and S are also shown for different latitudes.

Diagram Three illustrates all these points on earth, rather than sky, co-ordinates. I have shown the ground track of an orbit having apogee at 100°W (point A) and 80°E. Time markers in hours (measured from perigee over the South Pacific) have been included, to show the apparent slow movement three hours either side of apogee. The dashed line is the southern limit of coverage achieved from apogee A. A similar line could be drawn for the other apogee, but this does not concern us here. **Time of TV transmission:** Due to the fact that the USSR covers many time zones (it is mid-afternoon in the USSR far east before the sun rises in Moscow) **the Molniya system is in action 24 hours per day** carrying programming to some part of the Soviet Union. Electronic test pattern is radiated in the short intervals between program blocks transmitted to different regions. You will find that as each satellite moves **through apogee** there is a half-hour period during which your antenna need **not move**, but the further away it is from apogee, the faster it appears to move, necessitating an antenna adjustment every ten minutes at the beginning and end of the 6 (or so) hour period. If the signal **suddenly disappears**, service has been **switched** to the next satellite along the orbit, which will be found **approaching from the east** (orbital track is west to east, but the loop formed in the earth track results in the active arc at near apogee **moving from east to west**). A few degrees movement should pick up the (next) adjacent spacecraft.

The Molnias are believed to have an earth-coverage (17°) beam and an EIRP of 29 dBw. If this is an edge-of-earth value

MAKING MOLNIYA TRACK

Birkill's report detailing how you look for the inclined orbit of Molniya appearing here is based upon observations from his English location plus numerous calculations of the 'published' orbit data. Not everything checks out exactly so there is some room here for independent observations and reports. **Several Molniya orbits exist;** only one appears to be carrying television. That one is detailed here. Others are probably not carrying television (although we don't know for sure) so systematic checking of the northern sky is encouraged.

Birkill has checked for television on the inclined orbit described here at 0000, 0600, 1000, 1500, 1800, and 2100 (GMT) and he finds television operating at all of these times. **Published data** suggests an apogee azimuth at 47° west with an elevation of 48°, for a longitude of 71.5° west. **But** November observations had an average ascending node of 114° west which results in an apogee of 107° west. Thus we suggest looking for apogees around 100 degrees west; a scan **about this point** should pick up the Molniya (of the moment) at some point in its active arc.

Individual observations should be as 'calibrated' in apparent elevation and longitude location as possible. Remember to correct for your magnetic declination when utilizing a compass to establish your (true) north reference point.

we might expect 32 dBw at beam center, or perhaps 30.5 dBw in our direction; about the same as Satcom F1's even numbered transponders put into the south-east. So a bit sparkly on the average US TVRO, but a good picture on those with a 3 dB margin.

Now what about transmission systems and frequencies? The USSR uses the 625 lines 50 frame-per-second system, similar to Europe, and with SECAM color. What this means is that pictures **are easily resolved** on a US TV, **but not color**. I will

examine the subject in detail in a future article. Sufficient now to say that the line (horizontal) frequency is almost identical to that used in the USA, but the frame (vertical frequency is 17% lower - on some receivers or monitors you will need to **adjust the vertical hold control slightly** to stop the 625-line picture 'rolling'. You will also need to **reduce the frame height** to maintain aspect ratio (or things will look tall and thin). **That's all**, except pictures will be in black and white.

Audio is carried on two parallel systems: subcarrier FM, as used on the US domestic systems, except at a carrier frequency of 7.5 MHz; and an analog pulse-width modulated version of sound-in-synchs. **CSD** will publish demodulation details for this in the future.

Frequencies: For Molniya TV, channel **center frequency is 3895 MHz**, lying in transponder 10 in a 24-channel receiver. Transponder 10 receivers will be close enough. This is also the frequency of the Raduga TV transponder, and of **one** of those carried by Ghorizont. The other **Ghorizont channels** are 3695 MHz (not in the US band), 3745 MHz (in transponder 2), 3795 MHz (in transponder 5), 3845 MHz (in transponder 7) and 3945 MHz (in transponder 12). These five are **not** used by Molniya or Raduga satellites.

In all cases, polarization is **right-hand circular**, incurring a 3-dB disadvantage into your linearly polarized horn feed. The Birkill hybrid-mode corrugated horn feed will recover the 'lost' 3dB (see technical report on Birkill feed in this month's Technical Section). A reassurance to Birkill horn constructors: Coop's comments on double-sided PCB material (**Nov. 79**) don't affect its use for **this design** - it is just employed as a cheap, lightweight rigid ground-plane, the 'open' edge being well removed from RF fields, unlike the side-walls of a **rectangular** horn. Note also that a low-loss microwave type material would **not** help in the latter case - its low loss properties would aggravate any resonances it introduced!

My background being in communications technology, rather than orbital dynamics, I must acknowledge Martin R. Davidoff, Ph.D., of Baldwin, MD, without whose book **'Using Satellites in the Classroom: A Guide for Science Educators'** I would not have been able to calculate or plot the orbital paths shown in this article. The book, although principally concerned with the AMSAT-OSCAR amateur satellites, is a very **good introduction** to orbital dynamics and satellite coverage geometry. It is published by **Catonsville Community College, Catonsville, MD 21228**.

UPDATE ON GHORIZONT

The strange positioning of Ghorizont (Raduga 4) between 86.8 and 87.2 degrees west is another mystery. Birkill suggests the satellite is 'positioned there to provide **not** 6/4 GHz transponder service but rather to provide Cuba with an **8/7 GHz military transponder** for communication between Cuba and both Caribbean islands friendly to Cuba and/or Russian ships operating within its coverage area. Raduga class satellites are known to carry 8 GHz up and 7 GHz down (these are the **bands** utilized, not the exact up and down frequencies) hardware on board.

REAL WORLD TECHNOLOGY MATERIALS

Steve Birkill makes some of his circuit boards and past writings available on a **direct** basis to readers of CSD. All prices are in pounds Sterling which simply means that you must go to your bank and obtain a check/Sterling order in the proper exchange amount (as computed at the time the check is drawn).

2 Stage LNA Circuit Board - As originally described in CATJ for July 1979 and subsequently described in early versions of the Coleman TD-2 Conversion Manual. Board is Chase-Foster Di-Clad 1/32 inch PTFE-glass laminate, etched with the 2 stage LNA circuit but undrilled. Price is 10 pounds per board.

120°K GaAs-FET LNA - using 1 GAT-5 device (originally detailed in CATJ Magazine for December 1979). Circuit board per construction article (corrected) plus design and construction notes, addresses of U.S. component suppliers. Price is 15 pounds. Board is on 0.030" PTFE-glass laminate.

Consultancy Service - Birkill's unique background and knowledge in the satellite world equips him to find hard answers to hard problems whether North American oriented or world-wide in scope. Consulting by letter only, state your questions and objectives clearly. Response by airmail; price is 10 pounds per letter.

To order any of these Birkill materials, you may write: **Mr. S. J. Birkill, Real-World Technology, 128 Cross House Road, Grenoside, Sheffield, S30 3RX, England.**

SATELLITE POTPOURRI

OLIVER SWAN

Oliver Swan was possibly the most unselfish person I have ever met. He was also the most industrious, dedicated, hard working person I have known.

His talents and aptitudes for more than 30 years were channelled into things electronic. With virtually no formal training at all he quietly touched the lives of millions who never knew his name and moreover were not even aware of his presence on earth. Tens of thousands of amateur radio operators have made millions of two-way radio contacts all over



OLIVER SWAN

the world and even outside of this world because Oliver Swan in the early 1950's created a better way to funnel radio frequency signals into one specific direction. Thousands, possibly tens of thousands of people scattered throughout Mexico are receiving their first and only television via antennas and electronics conceived and probably hand built by Oliver Swan. Tens of thousands more all across the United States will today enjoy television reception made possible by Oliver because he unselfishly appeared at cable television trade shows through the years to teach cable system technical

personnel how to design better antenna receiving systems and signal processing electronics.

Oliver deliberately chose to maintain a low profile in life. He chose to return to his family's homestead along the Mexican border near Bisbee, Arizona when his father died because the 160 acre tract of land settled by his grandfather had been painfully wrestled into productivity by his ancestors and he didn't want to see it mis-used or turned back into desert wasteland. From this unprejudiced and often barren piece of real estate he and his family lived a quiet, simple, religious life. Blessed with a near ideal climate far from the ravages of winter and the man-made pollutants of an industrialized society Oliver's genius touched more than 400 of his neighbors because it was Oliver who made it possible for his neighbors to enjoy the benefits of television. Oliver knew he had a special gift and he graciously shared it with all who would ask.

Oliver could do more with less signal than anyone I have ever met. His initial devotion was to antennas. He invented the "logi" (the happy marriage that results when passive directors are added to log-driven active elements) and probably invented the log as well (in 1951). He was certainly the first to adapt both to television reception. Oliver had a rule of thumb. "If I can find and measure 5 microvolts or more on a two element yagi (dipole plus reflector) at a test site, I know that I can build that signal up strong enough with a stacked and phased array of my antennas to give people a good, viewable picture". And so he did at more than a dozen 'CATV' sites in southern Cochise County in Arizona. Over the years more than 400 southern Arizonians would 'connect' to Oliver's very small cable systems although many of these systems were not large enough to qualify as MATV systems (one has but three homes connected) let alone by-FCC-definition CATV systems. Yet each system, whether 3 or 200 homes served, would get the same attention and personal devotion because Oliver considered each viewer connected equally important.

PROGRAMMING CORRESPONDENCE

SCARED SPIT-LESS?

I read about CSD in the most recent edition of Co-Evolution Quarterly. Now we can have the most exciting thing in electronics in our own home and get the s---t scared out of us by tuning in the REAL honest to gosh stuff that is happening out there before it gets homogenized by the networks and other big brothers. Sign me up. I've got to have one of these things for myself!

H. Robertson
DeLancey, NY

Shame-shame. Tuning in the network news feeds on WESTAR or SATCOM before they get the New York editorial treatment could be dangerous to your health. Cover your dish with a geodesic dome to keep the "germs" away.

I visited Oliver's home twice in 1979. In February of '79 my visit was largely confined to videotaping Oliver's achievements for later airing on our **Satellite Magazine** program and thereby sharing with hundreds of cable system operators some of the genius of this man. I returned late last August to work with Oliver in gathering together the material one sees in the **Swan Spherical TVRO Antenna Manual** and again we managed to videotape several hours of Oliver's genius. Oliver's health had been a concern to me for several years; his body was carrying a determined and apparently dangerous level of a trace metal which we all need for survival but none of us need in excess. Oliver lived such a healthy life, the food his family consumed was largely grown on their homestead and he neither smoked nor drank, that it was with considerable surprise that I learned late in October that he had been operated on and Cancer had been found. Perhaps because of the excess of trace metal which his body carried Oliver had become a walking textbook on medical technology. He was curious about everything around him and could orate for hours on end about seemingly obscure subjects one never suspected he even knew existed. His mind assimilated everything it was exposed to and in the end his body was apparently no less selective.

Oliver leaves a considerable legacy for those fortunate to have been touched by his genius. His business life was about as untangled as his personal life but there is at least one piece of unfinished business. During my last visit Oliver asked me to help him find someone to take over (as in purchase, lease-purchase) his mini-CATV-empire. I agreed to do so. Oliver perhaps foresaw the future at the point or perhaps he only wanted to have the full time to devote to his TVRO experiments. In any event there is an Oliver-created opportunity here for someone with around \$30-50,000 to invest (with the balance payable out over the years) to 'retire' to the solitude and perfect climate of deep southern Arizona and to have his own complex of cable systems to play with. Interested parties should contact me directly at CSD.

Oliver....we miss you.

NOT IN

In your December issue you reported the following on page P-15-12/79:

Microdyne-AFC reportedly offering to set up firms as 'distributors' for private terminal sales for \$30,000 fee. This covers a demo system plus one in stock for re-sale and some spare parts."

This is completely erroneous and misleading. Microdyne Corporation has no plans, at this time, to set up distributors for this or any other market along the plans you outlined. We request that you print a retraction of this report and, in the future, should you wish to report on Microdyne's plans or activities, please extend us the courtesy of soliciting our input instead of reporting rumors. This we would expect from any responsible journalist.

George A. Bell
Director of Marketing
Microdyne Corporation
Ocala, FL 32672

CSD was told by a would-be distributor in Arkansas that he had a written proposal from Microdyne that stated the package reported. It never occurred to us that someone would 'make up' such a letter out of thin air although Bell suggests they did. Of late Microdyne has been very vocal in the CATV marketplace stating that they do not intend to sell private terminals as long as the 'piracy question' remains unresolved. Other trade press reports have noted that Microdyne was planning to announce a \$10,000 home terminal package 'about March'. We understand how some cable firms can put pressure on hardware suppliers to keep them out of the private market; the S-A withdrawal of HOMESAT testifies to the presence of such pressure.

PROFITEERING

If unauthorized reception of common carrier signals is illegal, why then does the FCC and the government allow the

sale of common carrier receiving systems? I wrote to the FCC and their response, in brief, was that for the reception to be considered illegal 'profit' must be involved. The word 'benefit' in the law is meant to mean 'profit'. If a championship fight is distributed via satellite for cable systems, there is nothing they can do if I sit in my own home and tune it in. The airwaves are free. Period. However, if I allow my neighbor to come into my home and I charge my neighbor to see that reception, no matter how small the charge, then I am profiting and that is what is illegal. In other words, the FCC tells me that if I do not benefit monetarily from the reception, then it does not constitute that I am taking monetary benefit from another. Non-profit reception of anything in the airwaves can never be considered illegal. However, I know that for now at least the argument will go on and on and on....

Hugh G. Vandegrift
Killeen, TX 76541

There are many strong 'opinions' about as to what 605 really means. Clearly, as Coop indicated in his 'Comment on Programming' on page P1 for November, the law gives us very little counsel as to who has what rights, when. Again we caution users of satellite services to 'be cool'; obtain the written authority of those programmers whose transponders you intend to intercept and stay tuned for what may be a several year series of legal battles to determine just where the law starts and stops in this grey area!

TUNING IN ON SRI-LANKA

I intend to set up a home earth station to receive satellite TV programming at Colombo, Sri-Lanka (Ceylon). I need some advice on how best to establish the receiving terminal, what satellites I can expect to receive, and what equipment will be required. I am an electronics engineer currently residing in Tanzania but will be relocating to Sri-Lanka soon.

M. W. Weerasinha
Tukuyu, Tanzania

Reception in various spots on the globe can be summed up as follows: Virtually any place south of 80 north and north of 80 south you can count on finding at least INTELSAT video. The newer domestic satellites serving nations, continents or regions have more limited coverage areas; but, much stronger [focused] signals. Add to this the ongoing launches of Russian Statsionar series 4 GHz geostationary birds [see Steve Birkill's piece this issue plus our November issue report in the Programming Section] and you end up with a choice of satellites virtually anywhere. No, HBO is not available in Sri-Lanka! [yet]

CAN WE SHARE IT?

We live in a mountain community in the eastern Sierra Nevada portion of California at about 8,500 feet altitude. We receive one NBC station through a translator arrangement which is not too satisfactory. There are about 50 people living here.

I would like to obtain information about acquiring or constructing a low cost satellite TV terminal and a rebroadcasting setup for one or two channels of service. it is not practical for us to run cables from the earth station because of the distances involved between residences and the heavy rock formations. What type of problems will we have to overcome? There would be no profit in this at all; it would have to be a cooperative effort. It will simply be for the good of the (50) people living here. Is FCC approval necessary? If needed, is it complicated?

Robert J. Tomko
208 Columbine Rd., Rt. 1
Bishop, California 93514

The FCC would have to be involved if you intended to rebroadcast the satellite signals from the TVRO site back into the airwaves. In January of 1978 the FCC approved changing the UHF (that's ultra high not very high) translator rules so that a (UHF) translator can get its input signal[s] directly from

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a satellite. Unfortunately it has only been during the past sixty days that the FCC has actually granted such permission to the first would be operator of such a system (a 1,000 watt UHF translator serving Denver with programming from SIN; Spanish International Network). Even a ten watt UHF translator on the used market will cost you upwards of \$5,000 to put onto the air plus the cost of the TVRO. And that's if you scrounge used everything to do it. A VHF translator on the other hand could be put into operation for between \$1200 and \$1500; less if you scrounge. But FCC rules at the moment don't allow you to legally feed a VHF translator with a satellite TV signal. That is the answer of course...but we cannot counsel you on doing it and breaking FCC rules in the process. If anyone wants to pursue translator rebroadcasting fed with satellite TV input signals we suggest you begin by contacting a qualified Washington attorney who knows how to get things done at the FCC. Contact Susan Cooper at CSD (by telephone or letter) and we'll give you our private recommendation in this area.

RURAL AREA TV

In the November issue of *Electronic Technician/Dealer* there is an article on earth stations describing the events of SPTS '79 in Oklahoma. I own and operate a TV sales and service business in the town of Wausaukee. This is a rural area with a population of 600+ in the village, ten miles south is another village with 1,000 and another ten miles is a third village with 600 people. These three villages and the surrounding countryside have around 6,000 people and the population nearly doubles in the summer as we are a resort area.

I am interested in starting a translator or rebroadcast type TV system. We have six television stations spaced from 65 to 85 miles away and the reception is very marginal most of the time. Can you give me information on setting up an earth station, microwave and a standard off-air system which could

then be re-broadcast at a VHF or UHF frequency? If it were to be rebroadcast at VHF or UHF, is there a type of "black box" a person could sell or rent to a customer so that a picture could be transmitted out of sync and the box would put it back into sync, thereby eliminating people who did not wish to pay for the service?

Parkansky TV
Wausaukee, WI 54177

FCC rules within the United States and territories make it illegal to 'scramble' translator (i.e. rebroadcast) TV reception for any purpose, including collection of fees for providing the reception. You have two viable options. Build a cable system for each of the three principle communities and thereby control who gets the service by only connecting up those people who pay the rate charged. Or, build an MDS (multipoint distribution service) transmitter (requires an FCC license) where you can either count on the relatively high frequency [2.15 GHz] to keep non-authorized viewers from watching, or you can (if you wish) scramble the service (requiring a 'black box' to decode it). Cable can be built in a rural-community area for less than \$5,000 per cable mile using modern, all solid state gear. If your cable plant can pass 30 or more homes per mile (averaged over the full system) you can make a go of it with a 5 to 7 year payout. A commercial MDS installation will set you back around \$25,000 (up) for the transmitter and the hardware per receiver will cost you around \$100 per installation. MDS is however limited to a single channel (although you could program it twenty four hours per day if you choose using multiple signals from the satellite). Cable rates are typically \$7 to \$8 per month for 'basic service' with an extra \$8-\$10 per month for optional premium service (i.e. HBO, et al). MDS rates are typically \$12 to \$15 per month plus a hefty \$100 to \$150 installation fee.

Several groups have proposed that the FCC authorize use of higher UHF TV channels for block transmission of multiple channels (say 5) of TV in a scrambled mode. The broadcasters get very uptight over this however and if anyone ever formally proposes this to the FCC it would probably take 2 to 3 years before acting upon and it would be battled all the way by broadcasters and others (including, now, cable interests). If there is sufficient support out there we'll talk about it some more since it may be a concept whose time has come. STT's Bob Cooper is conducting a special seminar session on exactly this subject during SPTS '80 in Miami in February.

START A BUSINESS

Your SPTS '80 Miami poop sheet indicated several hundred new business ventures are probably being formed in the satellite TV area. How can I find out who is active here in the Washington, D.C. area as a result of your SPTS '79? Have you some names from SPTS '79 from your registration list of people here in this area?

Kenneth S. Dewire
System Consultant
4807 NW 17 Street NW
Washington, D.C. 20011

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We have a simple policy on names and addresses. We don't give them out unless we have the approval of the person named. So we'll list your name and then let people in your area contact you. Which brings up an interesting idea. Suppose people in an area (say within a state for openers overlooking the size of Texas, Alaska and California for the moment) want to get together to share experiences, project information, and construction data. How do they locate one another? Since private terminals are no longer illegal at the FCC, it seems to us that we could start running a 'help wanted' segment in CSD. If you are working on a private terminal, or thinking about it, and would like to be listed, just drop us your name, address and telephone number along with 25 to 50 words about your background, strong abilities in this area and the state of your project. If enough people in a region could get together, we'd even consider loaning you guys some videotapes from the STT library list for a monthly meeting of the group. Let us hear from you at: c/o Help Wanted, P. O. Box G, Arcadia, OK 73007.

LIKES WHAT HE SEES

I have been watching a weekly program fed via cable here on satellite television technology and never fail to be fascinated. Unfortunately I find the technical aspects of it all way over my head. Currently I am in the broadcast programming field and leave to engineers what they do best. Is there a book or article you could suggest that is not too complicated, and capable of enlightening me about this field? Already somebody has directed me to CATJ but I found it largely concerned with cable television. I need a general, overall picture of what this satellite revolution is all about. Keep the show on satellite; I am a devoted if confused fan!

Gregory S. Wilson
Ft. Myers, FL 33901

Coop's weekly television program, *Satellite Magazine*, is distributed on RCA SATCOM FI Thursdays at 12 noon eastern on transponder 21. According to SPN (the folks who operate transponder 21) there are now more than 550 'communities' with something in excess of 1,500,000 'homes' receiving the service. However approximately half of the systems carrying SPN do so only for a portion of the day utilizing SPN programming as a 'filler' during those hours when some other service (such as HBO) is not operating. *Satellite Magazine* has noted a dramatic increase in viewer 'mail' in recent months and SPN seems headed for several million 'homes' on the circuit before we are very far into 1980.

SIN IN BRAZIL

I am interested in acquiring a satellite EIRP dBw contour map for transponder 7 of WESTAR II. In particular I would like to have the footprint for as much of Latin America (especially Brazil) as possible.

Gary Christopherson
Gamma Development Corp.
Chase, British Columbia

Sorry, The WESTAR footprints simply don't go very far south. Even the WESTAR III footprints (see CSD for December 1979, page P15) don't make it into northern South America except at levels in the 22-24 dBw region (according to Western Union data on file with the FCC). Taking the SIN Spanish language television into remote regions of South America is a great idea (they are on transponder 7 of WESTAR II) but unfortunately the signal levels are not there to support it...if the FCC filed maps are accurate (there is always the chance they are not!).

PARLEZ VOUS FRANCAIS?

I am a technician (a French native) living in southwestern Michigan and a subscriber to CSD; a great magazine! In your October issue, page 15, you talked about ANIK-B and the 11/12 GHz footprint. I am very interested since I would apparently locate in a good footprint area for ANIK-B and have restricted space to install my own TVRO. A 1.2 to 1.5 meter dish for 11/12 GHz would be ideal for my situation.

Can you supply the address of SED, the Canadian

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manufacturer, that has built the 11/12 GHz receive terminals? Or, could I get some type of 11/12 GHz TVRO terminal here in the USA for ANIK-B reception? Do I have to obtain permission from the French Canadian CBC network to receive their programs in the USA?

Andre Polizzi
Grand Rapids, MI 49504

SED is in Saskatchewan. They are NOT a very cooperative firm. Downright unfriendly would be a better description. They 'think' they have the Canadian 11/12 GHz market all wrapped up and we assure you that they will not do a thing which might cause political repercussions in Canada to

endanger their hold on Canadian 11/12 GHz receiver contracts with the Canadian government. Anything includes selling a receiver to a stateside viewer. Why watch French Canadian TV on ANIK-B's 11/12 GHz channel? The same program runs on the 4 GHz channel (transponder 8) of ANIK-B and for some unexplained reason the ANIK-B footprint seems skewed badly; to eastern stateside advantage. ANIK-B on 4 GHz is 3 dB hotter (10 watt output) than ANIK-3 or U.S. SATCOM's and that means that in the boresight a 1.83 meter (6 foot) antenna it is well above noise. In Michigan we'd expect you to find the ANIK-B 4 GHz channels so hot that a 6 foot with a 120 LNA would be 'perfect'. With a 12 foot + 120 LNA in far-southern areas such as Miami they are noise-free!

BIRD OPERATIONAL NOTES

Canada's much ballyhooed 12 GHz experiment is basically just that; an experiment. Service now includes Vancouver CBC network feed plus recent addition of CTV network station CHAN. Very few terminals have gone to private homes; those that have are for 'show' and publicity value. Most of the approximately 100 installed are at community centers or far northern low power TV stations or far northern cable systems dependent upon ANIK for CBC programming in the Northern service. Present terminals are custom ordered by Canadian Department of Communications from Saskatchewan SED firm. SED has been quoted as saying terminals could be produced "for as low as \$500 in quantity..." but present small orders and customized packages probably are costing DOC ten to twenty times that each. Official experiment runs only until end of March. Service is using two of four available ANIK-B transponders; most receivers delivered to date have been single channel for either CBC or CHAN feeds. Project is laudable but significance is primarily political and technological (Canada has aspirations of becoming world supplier of 12 GHz direct-to-home satellites and hardware).

COMSAT's proposal for U.S. domestic 12 GHz direct to home service is getting plenty of headlines (see **Coop's Comment on Programming**, this issue) much of it overlooking the fact that Congress, FCC and many others must approve program before it can 'fly'. COMSAT admits homeowners won't see first terminals "for three, possibly four years"; a projection CSD considers overly optimistic at best. Danger with COMSAT proposal is that it may slowdown rapid

advances in 4 GHz technology since publicity seems to be creating impression it is coming sooner than is likely.

European groups continue efforts to get together on a 12 GHz broadcasting satellite plan. Latest has French and Germans cooperating, with 1983 launch date forecast.

Modern Cable Programs (transponder 22 daytimes ahead of HBO sign-on) changes name to **Modern Satellite Network** February 1st. Service averages 5 hours per day showing 'free-be' type films.

HBO is raising rates to cable systems up to 25 cents per home per month. Most HBO contracts call for 50-50 split with cable operators of premium rates collected.

SHOWTIME is adding 3 more hours per day to programming schedule (9 to 12) but Warner's MOVIE CHANNEL remains only 24 hour per day premium service for time being.

Seven Alaskan communities (Wrangell, Nome, Kotzebue, Petersburg, Kodiak, Valdez and Cordova) will get Anchorage TV relayed via SATCOM FII (assuming there is transponder space for the service) fed to local low power re-broadcasting stations. FCC has approved service to be conglomerate of Anchorage source stations.

INTELSAT predicting they will be 'sold out' for available TV relay time during peak periods of Moscow Olympics. Most intriguing view of Olympic games may come to U.S. viewers **tuned in directly** to Russian **Molniya** satellite (see feature report this issue, Programming section).

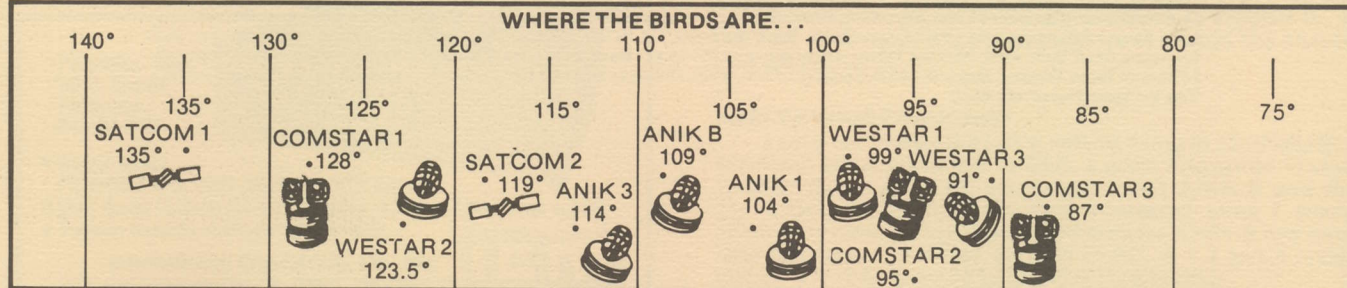
TIME-LIFE six hour per day feed of BBC and other British TV will cost cable systems ten cents per subscriber per month. Feed will actually be three hours long, repeat completely for western time zones. Transponder 20 is likely, start date April 1st.

Las Vegas and Reno now reportedly have no fewer than 12 operating TVROs at Casinos. Most are carrying ESPN to residents in hotels attached.

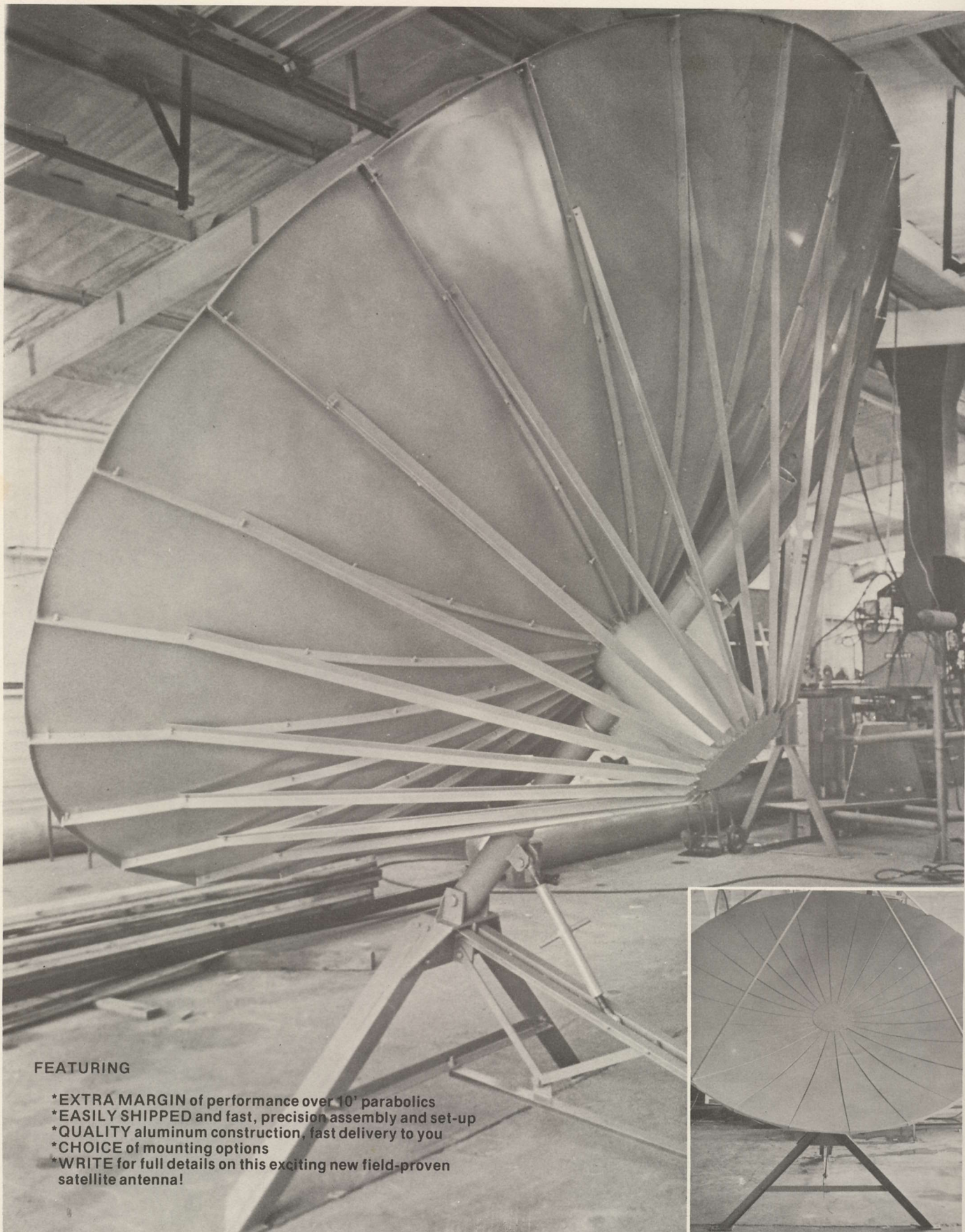
American Educational TV Network (AETV) has announced it will transmit educational service using transponders 10 and 12 prior to SHOWTIME daily programming before April 1st. Service designed to assist doctors, dentists, realtors, nurses, and others who must maintain professional licenses through ongoing education. This suggests anyone in that category could 'write-off' cost of terminal; presents interesting marketing opportunities for firms selling terminals. Information from AETV at 213-590-5691.

Ted Turner bought private terminal for news chief Daniel Schorr (who will head Turner's Cable News Network) as present at Christmas.

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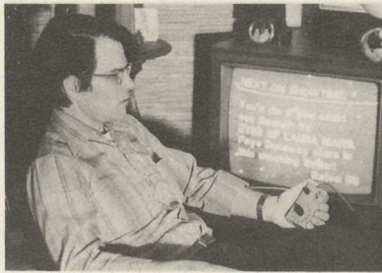
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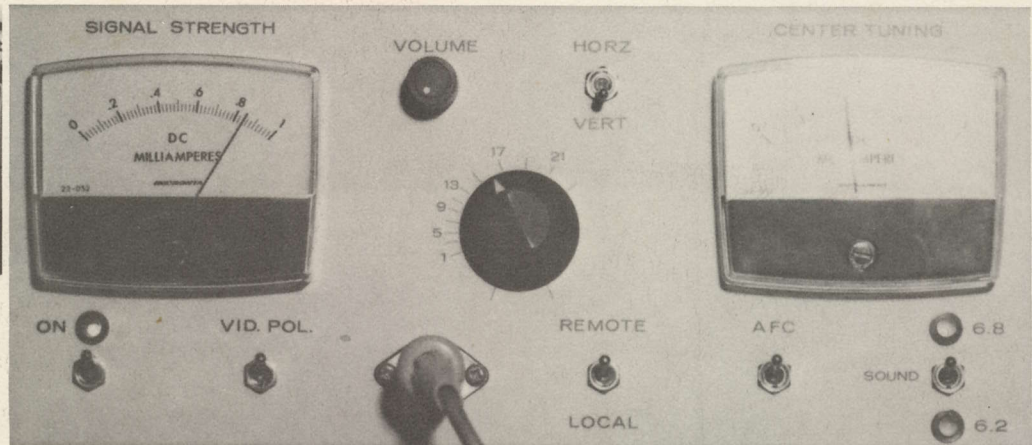
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